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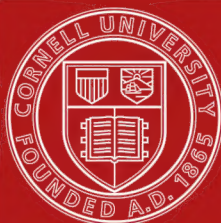
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PHYSICAL AND COMMERCIAL GEOGRAPHY

*A STUDY OF CERTAIN CONTROLLING
CONDITIONS OF COMMERCE*

BY

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PREFACE

From the time when they are first offered to the child for study, the facts of production and trade have been listed rather than interpreted. The books which have dealt with these matters have been prevailingly of a statistical nature, and the study of what they have had to give has too often reduced itself to a mere mnemonic exercise. And yet there are behind the facts of trade, as behind all facts, certain principles about which they can be grouped, and which serve to lend them life and meaning; and it is interpretation rather than arbitrary memorizing which is of educational importance. It is the reference to principles which tends to fix knowledge in the mind in a vital way; the principles form the nucleus about which a command of data can be extended.

The interpretation of the facts of trade calls for the inclusion of principles of many kinds. The popular persuasion that trade is a thing to be manipulated through laws, regulations, and the like has in it undoubtedly a considerable show of truth; but it is certainly the most superficial and least scientific view of the matter. Again, it is true enough that other social factors, in addition to the political, have entered largely into the controlling of trade, and so must not be neglected in the interpretation of its data. But the complexity of these social influences is so great that it is difficult to make an educational beginning with them. Nor are they the only factors that exercise a determinative influence upon exchange; there are controls in physical nature that are more concrete and simple of apprehension, and which have been, and still are, of great ultimate importance in the molding of trade, and, indeed, of human affairs in general. These, for want of a better and comprehensive term, might be called the environmental (or geographical) factors; they cover man's and society's relations with the whole natural environment.

In writing the present book the authors have been actuated by the desire to cover this series of relations—a series which, we are convinced, has received too little of systematic attention. Many books

dealing historically or scientifically with man and human society seem to us to have taken a partial, though perfectly natural, view of their subject when they have emphasized what the political or industrial organization has done for man, to the virtual exclusion of the influences of natural environment. That such a point of view was inevitable lies in the tendency of man to keep his eye fixed upon his own prowess and achievements rather than upon the limitations within which he must live and move all his days. It is not so much that the influences of natural environment are denied, as that they are ignored, or referred, at least, to the crude and distant past. Most intelligent persons would doubtless grant at once the great majority of the contentions which we shall set forth. Hence it is the trend of the chapters which are to follow, the collocation of many things accepted and some not so familiar, the attempt in our chosen way to infuse orderliness and sequence into the chaotic data and statistics of trade, which constitute the new departure in our treatment. We are not aware, at least, of any treatise in the English language which seeks systematically to bring together for the student the natural environment, the man, and the man's works.

Among the works of man we virtually confine ourselves to exchange, and to such extensions into the general field of societal life as are called for in the development of that topic. Strictly speaking, we present a medley of facts and conclusions which belong in part to physical geography, in part to anthropology, and in part to industrial history. We have fixed our attention upon trade rather than upon the societal organization as a whole, both because the interpretation of commercial data was that with which we started, and because we believe that in the content and streams of trade there appears, as it were, a sort of epitome of human doings in the struggle for existence — what men produce and what they want, in this place and in that. The simplest and primary organization in this struggle for existence is that of industry, involving the exchange of the products of industry; and we do not wish to go systematically beyond that in the present instance. Having in view, then, the influence of physical environment upon the most fundamental and material of human activities, we think that the study of the currents of exchange, involving, as that must, the consideration of the prime economic functions of production, consumption, and distribution, sets us in the midst of the issues upon which we hope to throw light.

For these reasons we have called this book "Physical and Commercial Geography." If there were some word meaning "science of environment," it might well have appeared on the title-page; but we have retained the better-known terms largely because of the very fact that they are more familiar, thinking it more profitable to try to introduce a more scientific character into what already exists than to seek the academic isolation of a new and unfamiliar term. Especially is the term "commercial geography" somewhat altered in our usage: it is widened to include something more than description; and it may seem to be narrowed in that no attempt has been made to secure an encyclopedic array of commercial data. We have consistently treated of types, and have renounced detail where multiplication of instances threatened perspective. For instance, in Part III, while retaining the old division by countries, we do not attempt to assemble exhaustive lists of the products of each country; under the basic political division—the only one yet practicable—our treatment is topical, a short monograph upon each preëminent article of commerce occurring under the general politico-geographical section which leads in the production or use of the article in question.

In the attempt systematically to correlate various phases of the natural and social sciences we can scarcely hope to have made more than a beginning. When more facts and relations shall have been collected by the natural scientists on the one side, and the social scientists on the other, it will be easier to construct a more consistent and orderly network of interrelationships. The chapters of this book will admit of much amplification in the class room before the contentions which we sustain, and their many corollaries, can be conceived in their full perspective. But we venture to believe that the instances needed to amplify (or to correct) our general contentions will meet the instructor, as they have met us in our years of teaching along the lines here laid down, at every turn.

When used as a college text, the course to which this book would correspond we conceive to be one linking together the natural and social sciences, and providing a fundamental set of ideas and principles touching human life-conditions that should be of use to one who might later pursue the study of the natural sciences, the social sciences, or history. For these same reasons we hope that what we have to present may prove to be of value to the general reader. As a text-book, however, besides adhering to arrangement and perspective

rather than to the development of detail, and besides leaving large latitude to the teacher, the present volume aims to attain certain pedagogical ends. The pages are spread with cross references in the hope that the teacher may profit by our own practice of keeping constantly before the student what he has already studied in other connections. It is assumed that the student or reader who uses this book has at hand some standard atlas of physical, historical, and political maps, and that these maps are used as an essential part of the study. We strongly recommend also exercises involving map construction, map location, and the use of inexpensive outline maps for representation of data regarding topographic and climatic details, distribution of products, of industries, and of man.

The triple authorship, corresponding practically to the three Parts of this book, expresses graphically our belief that the facts and principles involved in a study of the environmental relations of man require contributions from both the natural and the social sciences, and are best presented by a combination of workers from these two fields. Therefore while each author is directly responsible for the presentation of material from his particular field, the outline and general character of treatment is the joint work of the three authors. General editorial supervision has been exercised by the author of Part II.

Thanks are due to Dr. Bowman and Dr. Huntington for suggestions and for corrections made upon the proofs. And we remember with gratitude and affection the helpful interest in our ideas and work displayed by the late Professor Edward G. Bourne. For permission to reproduce illustrations, in modified form, we express our sense of obligation to Professors Tarr and Dyer, the *National Geographic Magazine*, and the United States Geological Survey. The leading sources followed have been referred to here and there ; but we have not sought to equip with full bibliographical apparatus a book which deals so largely with information easily accessible in unworked form. It is hardly necessary to say that we have made consistent use of the valuable publications of the several government departments, both of this country and of Canada—the Weather Bureau, Coast and Geodetic Survey, Geological Survey, Department of Commerce and Labor, Department of Agriculture, and so on.

THE AUTHORS

NEW HAVEN, CONNECTICUT

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**PHYSICAL AND COMMERCIAL
GEOGRAPHY**

PART I

THE NATURAL ENVIRONMENT

CHAPTER I

OCEAN, COAST LINE, AND HARBOR

OCEAN AND COAST LINE

GENERAL RELATIONS

1. Introductory. From the standpoint of human history the sea is a vast desert occupying seventy-two per cent of the earth's surface, practically uninhabited, impossible of settlement, to be traversed with risk, to be guarded against with care,—a desert whose dangers are unconquerable by savage man and offset only in part by the inventions of civilized races (cf. §§ 139, 192). Its waters rest in a vast sunken depression, variable in depth and extremely irregular in outline. It is a continuous water body which appears now in broad, open stretches, now minutely interlaced with the projecting land masses. Superficially, it is separated into the Atlantic, the Pacific, and the Southern oceans; the Indian and Arctic oceans are examples on a large scale of the bays, gulfs, and sounds which extend inland from the open sea.

The distances across these oceans are greater than is generally realized. From Morocco to Florida is a distance of 3600 miles, and the steamer route from New York to Liverpool is 3000 miles. A ship carrying freight from Southampton to Cape Town must travel 6185 miles, and the usual steamer route from New York to Buenos Ayres is one fourth of the circumference of the globe. In the Pacific the distances are even more impressive: on the equator it is 10,000 miles across this ocean, and on the Tropic of Cancer 8500 miles; it is 4750 miles from San Francisco to Yokohama, and in going from Vancouver to Hongkong the Pacific mail steamers must cover 6500 miles. Even Japan is 500 miles distant from China, and Madagascar

250 miles from the African mainland. Is it, then, any wonder that the distribution of plants and animals and the migration of man from continent to continent has been so retarded throughout the thousands of years of human history, and that each isolated land mass has developed its own race types and institutions?

The Pacific and Atlantic have played different parts in human progress, have controlled the efforts of mankind each in its own peculiar way. The reason for the different responses to these two oceanic environments is readily understood when their coast lines and bordering lands are compared. The Atlantic has 55,000 miles of coast line, — more than the Pacific and Indian oceans combined. Its shores are indented, furnish abundant harbor sites, and in places its waters are inextricably intermingled with the land. Furthermore, the lands of the world slope toward the Atlantic, and the great rivers of the world drain into this ocean. With an area of 35,000,000 square miles, the Atlantic furnishes an outlet for 19,000,000 square miles of land drainage, a ratio of approximately 2 to 1, while the Pacific, 70,000,000 square miles in area, receives drainage from only 8,660,000 square miles, a ratio of 8 to 1. Thus it appears, when viewed from a commercial standpoint, that the Pacific is a vast sheet of water separating continents whose interiors are inaccessible. The Atlantic, on the other hand, is relatively narrow, with near-lying continents and a large and easily accessible back country (cf. § 163).

2. Ocean floor. These salt waters, whose surface extent is so vast, extend also to great depths, making a liquid body inconceivably large in amount. Its average depth is over 2 miles (11,500 feet) and its deepest depression approximates 6 miles, a depth exceeding the height of the loftiest Himalayas.¹ Near shore the basins are shallow and the continents are fringed by zones of water 10 to 200 miles wide, with a depth of less than 100 fathoms. The British Isles are on such a continental shelf, and parts of the North Sea are less than 100 feet in depth, with scarcely water enough to submerge the ordinary church steeple. This fringe of shallow water determines the shore line, and slight elevations and depressions of the sea bottom or of coastal lands produce marked effects on the shore. The amount of ocean water, though vast, is limited, and if the floor of the Pacific were to sink 1000 feet, the sea level throughout the world would drop 500 feet. Even a change of 50 feet, such as has occurred many

¹ Nero Deep, between Midway and Guam islands, attains a depth of 31,614 feet. It was discovered by Admiral Bradford, in 1901, during the survey for a cable line from San Francisco to Manila.

times in recent geological history, would ruin the world's harbors and require the relocation of docks, breakwaters, and lighthouses.

If the waters were removed from this oceanic depression, a surface of lowlands, plateaus, plains, and ridges, covered with unconsolidated organic and inorganic sediments, would be revealed. The great diversity of topography, the remarkable variety of cliff and mountain and canyon which characterizes the scenery of the land, would, however, be lacking, for the prevailing characteristic of submarine landscape is monotony. If the ocean bed became the earth's lowlands, the present continents would become largely uninhabitable, and an ascent from the Atlantic bed to New York would involve scaling summits clothed in Alpine snow. Filling the oceanic depression with water has diminished heights by half, has lessened extremes of climate, and has bound the lands together by a common oceanic highway, much easier to traverse than an uninhabited land area of equal size.

3. Ocean and climate. The temperature of ocean water below 500 fathoms is uniformly cold, and at 2000 fathoms nearly reaches the freezing point; but the warmth of the surface varies with the latitude, position of winds, etc., and constitutes one of the controlling factors of commerce (cf. §§ 113, 142 ff.). The surface temperature in the tropics is 80° , in the arctics 28° . The daily temperature range is less than 2° , the annual range for any one place is rarely over 20° , and only in abnormal positions—areas where cold and warm currents come into contact—does the range exceed 50° . Such regions are pre-vaillingly foggy and constitute storm centers, as off Newfoundland, Cape of Good Hope, parts of Argentina, and northern Japan. As a regulator of climate the ocean is invaluable. It is heated slowly and cools slowly; its currents bring cold water toward the equator and carry warm water toward the poles. It tends to keep the air of uniform composition by absorbing and restoring atmospheric gases. Its surface allows the development of a regular wind system, and its vapors supply the land with rain (§§ 101 ff., 120 ff.). It is a barrier to plants and animals and savage man, and, though a highway for civilized man, it must be used understandingly. The quickest sailing voyage from England to New Zealand is around Cape of Good Hope, but from New Zealand to England the voyage is around Cape Horn, and the shortest course from Cape Town to Melbourne is impracticable (cf. §§ 189–190).

MOVEMENTS OF OCEAN WATER—WAVES

4. Introductory. With all the ocean's vastness of depth and expanse, its conquest by man would be relatively easy if the waters were only quiet. Any type of boat could then sail the ocean, and all coast lines would furnish available havens. The sea, however, is constantly in motion at the surface and in its depths, and no particle of water is even for an instant still. Ocean waters are disturbed by gravity, by the attraction of the moon and sun, by winds, and by changes of temperature, and though some of the resulting movements are regular and predictable, — seasonal, annual, daily, — others are entirely unknown in time and extent and place. Even at times of calm the waters are seen to be in motion, and rollers from some distant storm disturb the surface. At St. Helena it is often unsafe for boats to land even in fair weather on account of surf generated by storms of the North Atlantic thousands of miles away. The world's coast is under the control of the sea. Man has learned to escape its most violent outbursts by systems of protective works, but its power has not been overcome. In order to understand the relation existing between the sea and man, it is necessary to consider briefly those manifestations which have direct bearing on trade and human settlement. The chief activities of the sea with which man is concerned are recognized as waves, tides, and currents.

5. Wave motion. The nature of waves is difficult to realize. Looking seaward, crests appear to be moving rapidly toward the shore, and it seems as if floating particles must be brought swiftly to the land. A ship appears helpless in the path of waves large enough to submerge it and with a speed sufficient to hurl it against the shore. A little experience, however, demonstrates the fact that the water forming waves does not move forward by an amount equal to the lengths of the waves, and that ships or other floating objects merely rise and fall as the waves pass beneath them. The crest and trough change places; the form moves, but no flood of water is directed toward the shore. It is a "transference of form, not of substance." Close examination shows that the particles of water move in orbits; each individual particle starts forward, rises, retreats, and falls, completing its orbit during the passage of a single wave. A somewhat similar movement is seen in a field of standing grain over which the wind is blowing. The stalks crowd together, bend down, and return to their former position, causing a wave motion on the surface, but no real change of position. The fact that the wave form progresses while

the water remains practically stationary makes it possible to navigate the seas, for if the apparent speed of waves were an actual transference of water, no ship could live, even in fair weather. Even as it is, ships are so constructed that their natural period of swing is longer than that of any wave which they are likely to meet. Otherwise, the roll of the ship would steadily increase, causing it to capsize. In times of storms, when the waves follow each other in rapid succession, even the most carefully constructed ships roll excessively. A case is recorded from the North Sea where waves only 60 feet in length and 5 to 6 feet in height caused a 2000-ton steamer to roll at an angle of 30° to 40° .

6. Size, speed, and force of waves. Scoresby¹ recorded waves in the Southern Ocean a half mile in length with a period of 23 seconds, and Ross measured one 1920 feet long. The largest wave recorded in the North Atlantic had a length of 2750 feet, a height of 48 feet, and a period of 23 seconds. In general, waves in fair weather on an open sea are from 5 to 10 feet high, 50 to 100 feet long, traveling at the rate of 10 to 20 miles an hour,—about the speed of a slow freight train. Ordinary storm waves are 15 to 25 feet high, 400 to 600 feet long, and travel 35 to 40 miles an hour. Hurricane waves, with a height of 30 to 40 feet, a length of 500 to 1500 feet, sometimes attain a speed of over 60 miles an hour. Waves of such size, however, occur only in the open ocean away from the coast. For safety and comfort a ship should be longer than the longest wave it is likely to encounter, and the small boats constructed for navigation of bays and sounds could not be recommended for transatlantic service. In fact, the modern ship is about twice the length of the average wave along its path.

The destruction wrought by waves is dependent upon their size and the concentration of their attack. Ordinary waves possess great strength, but in time of storm these ridges of water exert power surpassing most other natural forces. Thousands of tons of water, armed with fragments of rock, are repeatedly hurled against the mainland. It is the force of a gigantic waterfall, increased by the absence of a cushion of water upon which to drop.

Unfortunately, harbor works cannot be designed to meet the ordinary waves, but must be constructed to withstand the strongest wave likely to occur. The average force of waves measured on the English

¹ The height of a wave is measured from trough to crest, its length from crest to crest. The period of a wave is the time elapsing between the passage of successive crests or troughs.

coast has been found to be 611 pounds per square foot in the summer months and 2080 pounds per square foot in the winter months. On November 20, 1827, a pressure of 6000 pounds (3 tons) per square foot was measured and a mass of rock 42 tons in weight was found to have been moved 5 feet. Measurements in the North Sea showed that a wave 20 feet high struck a blow of 1.23 tons per square foot. The force of storm waves on the breakwater at Cherbourg varies from 2.67 to 3.5 tons per square foot, and in one case 200 blocks of concrete weighing 4 tons each were lifted by the waves and thrown over the top of an embankment. Blocks of 12 tons' weight were turned upside down, and at Bilbao, in 1894, a block weighing 1700 tons was dragged from its place and dropped into the water. The bearing of these facts on the selection of harbors, plans for protective works, designs of ships, and the selection of routes is obvious.

7. Range of wave work. In the construction of piers, breakwaters, and buildings, the dredging of channels and the locating of sea walls, it is essential to know the vertical range of wave work, its power below the normal sea level, and the extent of its sweep above that point. The depth of water affected by waves is never great, and, in general, may be said to equal the height of the wave. The highest storm wave known would scarcely stir the finest sand at a depth of 100 fathoms, and breakwaters built of loose stones are found to be practically unaffected beyond a depth of 15 feet below low tide.

The presence of tides on a coast line gives the waves greater range, enabling them to strike blows higher on the shore and also to reach lower levels. Beaches and sea walls ordinarily beyond the reach of waves are thus brought within the danger zone. Stormy coasts with high tides therefore furnish conditions for the maximum wave work and involve the greatest expense for harbor construction. The importance of this tidal aid is well shown in the case of Galveston. This city, lying on a low barrier beach (§ 24), was ordinarily out of the reach of the destructive power of the small waves of the Gulf of Mexico. But when the water was raised by winds and tides the city was no longer safe. Galveston was destroyed by a wave only 4 feet high,¹ but one which came with great force at a time when the water had been raised by on-shore currents and the incoming tide.²

¹ *Monthly Weather Review*, September, 1900.

² The Galveston hurricane, September, 1900, was one of the severest storms that ever occurred in the United States. Property to the value of \$30,000,000 was destroyed and 6000 people lost their lives. To prevent the recurrence of this disaster Galveston has constructed, at an enormous expense, a great sea wall 17 feet in height and has raised the entire city between 8 and 12 feet.

8. Seaquakes. The most destructive waves which visit the shore line are caused by the dislocation of parts of the earth's surface by seaquakes, which are identical in origin and effect with the earthquakes of the land.¹ As observed from shore, the water during a seaquake withdraws from the land, then returns with great speed as a wall 10, 20, or even 40 feet in height, carrying everything before it, — a process which may be several times repeated before the water finally subsides. The western coast of South America is particularly liable to be visited by these seaquake waves. Harbors at Pisco, Arica, Tacna, Iquique, and Pisagua have been repeatedly subject to destructive seaquakes of great power. In 1868, and again in 1877, northern Chile and southern Peru were visited by waves of the greatest intensity, particularly in the neighborhood of Arica, where most of the structures in the city were thrown down and ships were washed inland as if they were chips. A seaquake in the North Pacific, in June, 1896, produced waves 10 to 50 feet high on the northern Japan coast, laying waste 175 miles of coast line and causing great destruction to buildings and cultivated lands. Ships were crushed or carried away and 27,000 people lost their lives.

9. Wave-made currents. Wind waves may advance parallel with the shore, and the water thrown upon the land will then be removed by the undertow. If, however, the waves strike the land obliquely, there is developed a shore current by which the water is carried along the coast line. Rarely does the wave front coincide with the coast line, and shore currents are therefore present on all the continental borders. This is particularly true in regions of prevailing winds, which give a definite trend or "set" to the waters along the shore.²

Wave-made shore currents may be sufficiently developed to appear as definite streams of water, and, in such cases, they have molded the coast line in a characteristic manner. Their presence is indicated by the wreckage of ships, which rarely comes directly to the shore, but drifts along the coast in a definite direction. Wreckage from Fire Island is occasionally picked up as far westward as Manhattan Beach, and material is carried northward along almost the whole extent of New Jersey.

¹ Such unusual waves are commonly spoken of as *tidal waves*, but they really have no connection with the tides.

² In extreme cases large quantities of water are heaped upon the land under the influence of unusually strong, constant winds. On October 5, 1864, wind blowing shoreward at Calcutta piled up water to a height of 24 feet. The Quinnipiac meadows at New Haven, usually above high tide, are occasionally flooded by a sea of water heaped up by a southwest wind; and a continuous northeast wind blowing on the waters of Lake Erie has been known to render Niagara Falls practically dry.

These wind-made shore currents, developed directly from waves, are responsible for the sand bars and spits and stretches of silt which demand the chief attention of the harbor engineer. The set, or direction, of these currents, their speed and carrying power, are elements of prime importance in harbor location.

10. Oil on waves. Oil spreads rapidly on water, even against strong winds, and by its use the violence of waves may be reduced. Many a ship has been saved by the use of oil; sailing masters are instructed in the best methods of applying it. Oil does not prevent the formation of waves, but by furnishing a smooth surface to the wind reduces its "catch," thus preventing waves from breaking at the crest and making it difficult to pile the water to great heights. If the crest is not allowed to form, the waves are robbed of their destructive power, which is due to the slight but exceedingly rapid advance of the top of the water wall.

MOVEMENTS OF OCEAN WATER—TIDES

11. Nature and cause of tides. There is a movement of ocean water entirely independent of winds and unaffected by temperature changes, as a result of which the water rises twice during the day and as often withdraws from the land. This is the *tide*. It is a great wave originating in the Southern Ocean, where the attractive force of the sun and moon produces its greatest effect. From this place of origin two tides are daily propagated over more than 16,000 miles of ocean, thousands of miles of bays and estuaries and rivers and creeks, a movement which involves every particle of water. This wave, where it is unobstructed, is nearly 6000 miles in length, and travels at the rate of 500 miles an hour. In water 40 feet deep the length decreases to 300 feet and the rate to 25 miles per hour. In the shallow parts of the ocean and near shore this great tidal wave is converted into a current which rushes through narrow passages, blocks bays and estuaries, and, sweeping through channels, develops innumerable whirlpools and eddies which may seriously interfere with navigation. On gently sloping shores the advance and retreat of the tide alternately covers and uncovers large areas of the sea bottom, changing the position of the coast line twice each day.

The essential cause of tidal motion is the attraction of the sun and moon, which causes the water to rise as it passes beneath them. The moon is much more efficient because, although a small body, it is but 240,000 miles distant, while the sun is separated from the earth

by a stretch of 93,000,000 miles. Under the most favorable conditions for solar influence a tide 2 feet in height would owe 1.4 feet of its elevation to the moon and 0.6 foot to the sun.¹ Twice each month, however, the influence of the sun is markedly felt: namely, at new and full moon, when the combined activities of sun and moon result in making an unusually high tidal wave,—the so-called *spring tide*; and at the first and third quarters of the moon, when an unusually low wave—*neap tide*—is produced by the conflicting attraction of the sun and moon. The change from spring to neap tide is often considerable. In the Bay of Fundy a spring tide of 50 feet is reduced to a 24-foot neap tide, and at Astoria, Oregon, the 7.4-foot spring tide is reduced to 4.6 feet at the first and third quarters of the moon.

The prediction of the height of tides would be a simple matter if the earth were covered with water, but the continents, with their diversified coast line, cause much complication, and the height and time and velocity and duration of the tide must therefore be determined for each place separately.

12. Relation to the land. In the open ocean, away from land bodies, the tide has a height of 1 to 2 feet, but when the wave is crowded against the shore and changed into a current, the height increases rapidly to a point determined by the configuration of the coast line. The momentum obtained in the open ocean forces the water far up bays and rivers and creeks of the land, and under normal conditions the farther the water is crowded inland the higher the tidal wave. For instance, the spring tide at the mouth of the Bay of Fundy reaches a height of 11 feet; at St. John it has become 27 feet; at Advocate, 39 feet; in the Petitcodiac River, 46 feet; and in the Noel River, 53 feet. When a sea expands after passing through a contracted passage, the tide may decrease in height as it approaches land; for example, the tidal wave entering the Caribbean Sea and the Gulf of Mexico decreases to 2 feet, and at some places in the Gulf there is but one tide a day; a tide of 6 feet at Gibraltar is diffused in the Mediterranean until it reaches the scarcely perceptible movement of 3 or 4 inches. Tidal currents act as rivers in scouring the bottom, carrying silts and sands to and fro within the bays, and depositing them over the sand flats. They become the chief obstructive agents with which the harbor engineer has to deal.

13. Races and bores. In bays connected by narrow channels unusually dangerous whirlpools and currents may be developed, for,

¹ Wheeler, Practical Manual of Tides and Waves.

owing to the configuration of the coast line, high tide may occur in one bay at the same time as low tide in the bay adjoining. The movement necessary to reestablish the water level produces the currents recognized as *races* or *eddies*. Such races have always been the bane of navigators from the times when the Maelstrom of the Lofoten Islands and Scylla and Charybdis in the Strait of Messina first won their evil reputation. The races at Pentland Firth, Elizabeth Islands, Strait of Magellan, and Cape La Hague are shunned by modern seamen; and only by the removal, at great expense, of obstructing rock material at Hell Gate has the passage into Long Island Sound been rendered fairly safe for ships which ply between New York and the cities of the New England coast.

At the mouths of certain large rivers tides develop features which make them particularly dangerous to shipping. Huge waves in these cases may run up the bays with great speed, sweeping everything before them. Under the name of *bore* (*aeger*, *hyre*, *mascaret*, or *pororoco*) these gleaming walls of water are known in all lands. Where bores occur, the tide comes in not as a gradual increase in volume but as a wave crest which rushes with great speed over the top of the stream. Bores in the Severn, the Trent, the Seine, the Garonne, the Petitcodiac, the Hooghly, and the Amazon exhibit the same features, varying only in speed and dimensions. In the Bristol Channel the bore enters the Severn with great force, and in 1606, 1687, 1703, and 1883 was unusually destructive. In the Amazon at new and full moon the sea swells to its greatest height in one or two minutes, and the noise of the rushing waters is heard at a distance of six miles. "Presently you see a liquid promontory 12 or 15 feet high, followed by another and another and sometimes by a fourth. These watery mountains spread across the whole channel and advance with a prodigious rapidity, rending and crushing everything in their way" (La Condamine).

In Hangchau Bay the water advances in the form of a wall $2\frac{1}{2}$ to 3 miles wide, 10, 12, or even 20 feet high, and runs at a speed of 10 to 20 miles an hour. Ships and ordinary protective works are helpless in the face of such a tremendous current of water, and the poorly constructed dikes of the Chinese rivers entail great annual loss of life and of property. Because of this bore, Hangchau, which is on the main tributary of the bay and is the capital of Chekiang and the center of the silk-producing industry, has practically no connection with the sea, and the more favorably located Shanghai is in possession of the export trade.

14. Tides and harbors. The coming and going of ships from the land is largely governed by the tides. Fishing boats and other small craft time their daily movements by the tide, and there are few harbors which do not depend upon tidal rise for the safe exit and return of their vessels.

If the moon were suddenly to be struck out of existence, we should be immediately apprised of the fact by a wail from every seaport in the kingdom. From London, from Liverpool, from Bristol, we should hear the same story — the rise and fall of the tide had almost ceased. The ships in dock could not get out; the ships outside could not get in; and the maritime commerce of the world would be thrown into dire confusion.¹

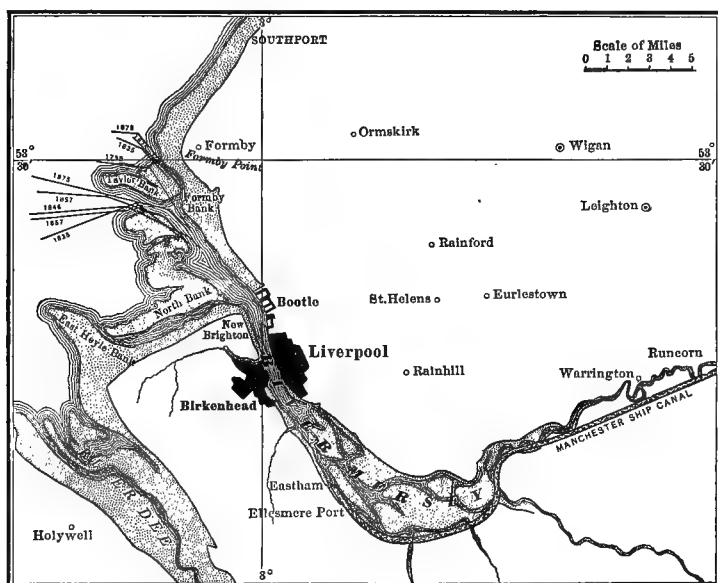


FIG. 1. Mouth of the Mersey and Port of Liverpool

Many large rivers without tides, which would normally furnish convenient access to the interior, are practically closed to navigation unless deepened by artificial means. The Mississippi, 50 feet deep above its mouth, has a natural depth over the bar of 13 feet. The Danube, draining 316,000 square miles, in its natural condition has a navigable depth of 7 to 12 feet, and the Rhone is rendered navigable only by the aid of canals connected with the sea (§ 34). The Neva has 13 feet of water, the Volga 8 feet, and the Nile is navigable with difficulty below Cairo. On the other hand, the Mersey, with a drainage

¹ Ball, *Story of the Heavens*, p. 49.

basin of less than 2000 square miles, makes Liverpool a great seaport, owing to a tidal rise of 27 feet (fig. 1). The tides make the city of London an important shipping center, though it is 46 miles from the sea. And for the same reasons ships of considerable size may call at Hull upon the Humber, 23 miles from the sea; at Rouen, 77 miles up the Seine; at Hamburg, 60 miles up the Elbe; at Rotterdam, 20 miles up the Maas; at Antwerp, 45 miles up the Scheldt; and at Bordeaux, 75 miles up the Garonne. Philadelphia is a seaport nearly 100 miles from the ocean, and ships of large draft navigate the Hudson to tidewater at Albany. Bristol, England, is an example of seaports which owe their entire existence to the presence of tides. Vessels of 2000 tons may visit this city, and ships of large size trade with Chepstow and Cardiff, because of a tidal rise of 32 feet. Without the tide the Avon would have a depth at low water of less than 4 feet.

Because of the inability to enter harbors except at times of high water, it is necessary for sailing masters to know the facts regarding time and height of tides for any port which they may wish to enter. Tables are published for navigators which give the "establishment of the port," that is, the time of arrival of high or low water as compared with the position of the moon. For example, the establishment for New York is 8 hours 13 minutes; that is, high water occurs in New York harbor 8 hours 13 minutes after the transit of the moon.

15. Tides as scavengers. The sewage of great coastal cities is diverted directly into the ocean, and the ebb tide acts as a scavenger, carrying waste materials to distances beyond reach of the shore line. Cities many miles up tidal rivers take similar advantage of their position. The importance of the tide in this connection may readily be seen by comparing the expense and the safety of the sewage disposal of Berlin with that of London, of New York with that of Peking.

16. Tidal currents. When the tide is transformed into a current along the shore line it becomes a factor which must be taken into account. It flows toward the land or alongshore with sufficient strength and velocity to carry the largest ship, and ignorance of the "set" and force of these currents has been the cause of many wrecks, as on the south coast of Ireland, the west coast of France, etc. So important is a knowledge of these currents that the Lloyds have especially equipped ships for the study of uncharted tidal currents on the European coast line. When the position and speed of these currents are known they become an aid to navigation. The wash of tidal currents

through openings in the coast is often sufficient to scour channels and to move and deposit large quantities of silt, shifting it to and fro with the changing direction and velocity of the tides and making mud banks in unexpected places. It is impossible to chart such an inlet; maps are accordingly left blank with regard to such features, and the navigator must trust to the knowledge of the local pilots.

MOVEMENTS OF OCEAN WATER—CURRENTS

17. Introductory. In addition to waves and tides there is a movement of water in the sea which produces streams with more or less clearly defined borders and with fairly constant speed and direction. These belts of moving water are the *ocean currents*, and they may take the form of a broad, shallow sheet advancing at the rate of 5 to 15 miles a day, that is, a *drift*; or they may exist as a more or less definite current confined within narrow limits and flowing at a rate of 50 miles or more a day, that is, a *stream*. In addition to these surface movements there are deep-sea currents or drifts of slow speed and of universal distribution. The evidence for the existence of such ocean currents comes from several sources: derelicts are found to take more or less definite paths, and driftwood is seen to travel over the same route year after year. Wood from the tropics and wreckage from ships on the American coast drift to England and Scandinavia in sufficient quantities at times to furnish fuel supply, but derelicts of northern Europe do not reach America. Nansen noticed driftwood from Siberia on the east coast of Greenland, and used this observation as the basis of his exploration toward the pole. Within the last century bottles containing paper requesting the finder to report time and place of discovery have been thrown overboard from many ships, and their direction and speed have been carefully noted. More recently ships, especially those making voyages of discovery, have been supplied with small oak casks which contain notices printed in several languages. Hundreds of these floats are set adrift each year and their tracks are carefully recorded by the various hydrographic bureaus. Thus during the three years 1885–1887 the Prince of Monaco alone sent out 1600 bottle floats and within four years had recovered 227 of them. By these chance methods the position of ocean currents has been largely determined, and many interesting results secured. For instance, it was discovered that it took two and a half years for a bottle to make the circuit of the Atlantic, and some of the floats deposited by Benjamin Franklin traveled for thirty years before they

were picked up on the Pacific and in the Gulf of Mexico. Another way of determining the direction and, at the same time, the speed of currents is to observe the courses of steamships which have drifted from their tracks. Hundreds of cases have been reported where ships find themselves out of their course in spite of the fact that most careful observations of their position have been made. So important is this matter in commerce that current charts have been issued by various governments since 1830, and in places where wind and tidal currents combine with ocean currents to produce exceptional drifts marine-insurance companies find it advantageous to conduct special surveys.

18. Currents of the different oceans. - Examination of a current chart of the world¹ shows that the water drifts westward on the equator until it impinges on the continents. It then turns poleward, crosses the oceans in middle latitudes, and returns toward the equator, thus completing a more or less regular eddy whose size and dimensions correspond with the different oceans. In the Pacific the size of the ocean and the arrangement of its bordering continents make a simple expression of current action possible. Both the North Pacific and South Pacific oceans seem to possess eddylike currents that move slowly around them, leaving the central parts relatively quiet; the northern eddy moves from left to right and the southern from right to left, the velocity of the eastern drift being about 4.4 miles per day and that of the western drift 10 miles per day. The fastest current measured runs 26 miles per day, past the Gilbert Islands, and the longest continuous current, from Cape Horn to Cape York, requires three years to cover its course.

In the Atlantic the western drift is seen to divide at Cape San Roque, part of it going north into the Caribbean Sea and part southward along the Brazilian coast. The eastern side of the Atlantic is occupied by a number of minor strands of a general oceanic drift. The Gulf Stream is the most marked feature of the Atlantic circulation. It starts in the Caribbean Sea and Gulf of Mexico, where the water is accumulated by continuous winds until the sea level off the Florida coast is 40 inches higher than at New York. Leaving the Strait of Florida, the Gulf Stream is a river 40 miles wide and 3000 feet deep, with a velocity of 5 miles an hour. As the current travels northward under the guidance of the coast and the prevailing westerlies it widens, goes more slowly, and, in about the latitude of Newfoundland, becomes a drift moving at about one mile an hour.

¹ It is assumed that the reader has at hand an atlas or some elementary text-book of physical geography.

In the Indian Ocean a warm current through Mozambique Channel strikes the Agulhas Bank, where it is divided, part of it returning eastward and the other part continuing around the Cape of Good Hope into the Atlantic. "The strength of the current on the shallow bank (Agulhas) produces one of the roughest seas in the world." This ocean exhibits the anomalous condition of currents flowing part of the year in one direction and part in the opposite direction, changing in sympathy with the shifting monsoons (§ 103).

19. Currents and man. Ocean currents have practically no effect in molding the coast lines of the world, but in two important particulars they have exerted control over man's activities, namely, modification of climate and determination of trade routes. Their principal climatic influence is their effect on temperature. Without currents the surface of the ocean would be divided into zones of temperature corresponding with latitude, that is, hot in the tropics, freezing within the arctics; but the presence of currents results in an irregular distribution of hot and cold water, greatly affecting the climate of coast lines and producing apparent anomalies. The harbor of Hammerfest, in latitude 76° N., does not freeze; New York harbor, in latitude 40° N., does. Labrador is cold and bleak, while England, on the same parallel of latitude, is an agricultural region. Corals will not grow on the Galapagos Islands, directly under the equator, although they flourish in Bermuda, in latitude 32° N. Fuchsias grow on Vancouver Island when Montreal and Quebec are icebound, and certain Alaskan trees cannot endure the cold winter climate of New England.

The west coasts of continents in the southern hemisphere are visited by currents from the poles and are also affected by cold water which rises to replace the warmer surface water drifted away to the westward. The last-mentioned phenomenon accounts for the fact that a uniform temperature exists over a wider range of coast line than might be expected. Thus the water at Callao, 12° south latitude, is no warmer than that at Valparaiso, 33° south. In fact, the whole western coast of South America, from 5° south to 40° south, is washed by cold water. The same condition exists in the Atlantic Ocean from Gibraltar to Cape Verde and also from latitude 10° south to Cape Town.

In general, the combined influence of currents and winds is to make one side of the oceans warmer than the other in the same latitudes. Along the equator, and for about 10 degrees on each side, westward-moving currents warm the continental coast line, making Brazil, Guam, the West Indies, and the East Indies warmer than

Morocco, etc., in corresponding latitudes. In middle and high latitudes of the northern hemisphere the west coasts of continents receive the warm currents and the east coasts the cold. The result is that Alaska has a number of ice-free harbors (§ 321), while on the corresponding coast of Asia, Russia has been able to make little headway against the ice which blocks her ports (§§ 26, 171). Unusually high temperatures exist in the North Atlantic, due to the configuration of the South American coast, which directs a large part of the equatorial current northward, and to the fact that the westerlies, which carry warm air poleward, are unusually effective in this ocean (§ 102). The Gulf Stream and the westerlies greatly modify the climate of northern Europe, while the winds rising from the cold Labrador current are in part responsible for the climate of northern New England.

The influence of ocean currents on migration and location of trade routes is obvious. The distribution of animals, of seeds, of plants, as well as the accidental oceanic migrations of men, was necessarily in the direction taken by currents, and the navigation of early civilized peoples was helped or hindered by currents. A knowledge of the direction of ocean drifts has always been an important asset in shipping. Thus American seamen of early colonial days were aware of the presence and importance of the Gulf Stream, as indicated by their expression, "it is downhill to England"; and they had discovered that, owing to this stream, the trip to England could be accomplished in considerably less time than the return voyage. Even at the present day sailing vessels take careful account of currents and their accompanying winds. For instance, when bound from the United States to South America they cross the equator well to the eastward. The use of steam makes it unnecessary to pay so much attention to the direction of currents, but there is still a large amount of ocean traffic which must take careful account of the location of oceanic drift (§§ 189-190).

HARBORS

20. Introductory. In the earliest stages of man's development the ocean was a barrier; with the advance of civilization it became the chief highway of communication. It would be a rare experience in the present century to traverse the sea in any direction without meeting ships of various designs, constructed for different purposes, manned by people of various races, and plying between widely separated ports. Ships without keels require no special harbors and may be drawn up on the beach of any coast line; but such ships, even with the

construction of outriggers, are not adapted for long voyages except in quiet water. Trade on any large scale must be carried on in keeled ships, and such ships require quiet-water anchorage. The coast line best designed for the development of commerce is an irregular, indented one, with numerous offshore islands; and this fact may well account for the development of Norwegian and Malay navigators of prehistoric times, and in part for the apparent lack of interest in shipping on the part of the Egyptians, the subjects of the Incas, and the Aztecs (§§ 168-170, 187, 194). Even to-day the eastern Mexican coast is without good harbors, and from Progreso to Tampico are long stretches without ports. The unloading of ships except by transfer to lighters is often impracticable, and then only goods securely packed in small packages can be handled readily. Even at Vera Cruz, the chief port of Mexico, ships must anchor in the offing, though port works now building will soon improve this condition.

CONTROLLING CONDITIONS OF HARBOR LOCATION

21. Good harbor sites are found, not made, and their location and distribution depend upon conditions beyond the range of human activities. A channel may be dredged here and there and an artificial harbor may be constructed if conditions are favorable, but a natural harbor is a commercial asset of surpassing importance, which gives the people possessing it a distinct commercial advantage over their neighbors, — an advantage not to be offset by the expenditure of a nation's wealth in an effort to entice ships to a rendezvous not selected by nature. Good natural harbors are not the result of local pride nor of legislative enactment, but depend upon the physiography of a coast line and the force and direction of waves and currents (§ 192).

22. Physiography of the coast. In general alignment the shores of the world present a variety of aspects: here long stretches of unbroken coast; elsewhere an abundance of islands, capes, bays, and inlets. Parts of the coasts are rockbound, others are bordered by stretches of low-lying sand. In places deep water adjoins the land; in others a fringe of sands and shoals forms the shore. This variety of coast physiography is due fundamentally to movements within the earth's crust which have resulted in the elevation or depression of a shore line within recent geological time.¹ The effect of elevation is to

¹ The coast of Chile has risen 20 to 30 feet in the last two hundred years. The Swedish coast has risen 3 feet a century for the length of 200 miles. The Netherlands are sinking; Chicago is sinking; and the New York-New Jersey coast is sinking at the rate of 1.56 feet per century.

expose to view the continental shelf, — land which is now under water (§ 2). Such lands have a gently sloping floor coated with deposits of sands, gravels, and clays. The elevation of such a sea bottom results in a regular coast line of soft materials; for example, the coast of Texas. Depression, on the other hand, produces marked irregularities, an effect which is readily understood if we consider an uneven land surface diversified by hills, valleys, and plains, and imagine it to be depressed so that the water would flow in around the hills and ridges. For example, the Maine coast, characterized by a wilderness of capes, promontories, islands, and narrow channels, owes its existence to depression of the land, and forms a marked contrast to the straight, even stretches of sand beach on the eastern coast of Florida. If the original shore line were mountainous, depression would produce fiords and rockbound bays. If bordered by plains, an entire river system may be drowned; stretches of fresh water become tidal estuaries, as in the case of the Hudson; and tributaries become detached from the master streams, as in the case of Chesapeake Bay, where an entire river system has been rearranged and ancient tributaries to the Susquehanna and Potomac now enter the bay as independent streams.

The coast line furnished by elevation or depression is molded by waves and currents, and to these agencies we owe the details of coast topography, — the cliffs, beaches, bars, spits, sand flats, and lagoons which affect the movements of coastwise trade and determine the character of protective works.

23. Wave work. Waves develop cliffs, and with the aid of currents to ferry away the débris, may remove stretch after stretch of land. Shores of soft material are rapidly eroded, those of hard material slowly, but, the process of erosion is the same and the retreat of a coast line inevitable. During historical time sites of villages have disappeared, and deep water now occupies the place of cultivated fields. Islands have been reduced in size, some of them entirely destroyed, and converted into shoals to be avoided by navigators.

On the Yorkshire coast, England, between Bridlington and Kilnsea, a distance of 40 miles, the coast has been wasting at the rate of 7 feet per year. The townships of Wilesthorpe, Auburn, Hartburn, Withon, and Cleton are all buried by the sea. Thorpe parish has been reduced from 680 to 140 acres, and the villages of Shipden, Whimpuwell, and Eccles have entirely disappeared. No vestige is left of Ravenserodd, a seaport at the mouth of the Humber during the reign of Edward I. A strip of 2 miles in width has been cut from the eastern coast of England since the time of the Romans. Dunwich, once a flourishing port in the time of Sigefert, king of the East Angles, has disappeared. The island of Helgoland,

at the mouth of the Elbe, has decreased from a circumference of 130 miles in the year 800 A.D. to 3 miles in 1900. Near Chatham, on the coast of Cape Cod, the shore has been retreating one foot yearly, and the rate of retreat at Martha's Vineyard and Nantucket has been even more rapid. Goodwin's Sands, Dowsing Sands, Race Shoal, etc., are remnants of islands which have entirely disappeared.

24. Work of shore currents. The sea is not satisfied with an irregular coast line, and the tendency of shore currents, produced by wave and tide (§§ 9, 16, 23), is to outline the continents with long lines of beach and bar, to unite promontories, to close inlets and fiords, and to replace all irregularities with curving embankments of sand. If no other forces were at work, the coast would develop long swinging curves where

the shimmering band

Of the sand beach fastens the fringe of the marsh to the folds of the land.

The work of shore currents has progressed so far that much of the world's coast line is bordered with long sand beaches, which stand as barriers between the sea and the land and prevent access to the interior. These *barrier beaches* are well exhibited on the Atlantic coast of Long Island, New Jersey, the Carolinas, Florida, and Texas. Lines of sand beaches from a half mile to ten miles in width are molded by the waves on the ocean side and inclose lagoons back of the beach. So continuous are these sand ridges on the Atlantic shore that a small boat might be navigated from Virginia to Biscayne Bay without going outside of the beaches. In fact, it has been proposed to construct a canal along this route, to avoid the dangers of Hatteras. Inlets occur through the beaches at frequent intervals. They are kept open, partly by the river currents, but particularly by the tidal currents which wash back and forth through them. Where inlets are absent, access to the land is cut off for long distances. On the Jersey coast, where the tide is fairly strong, the inlets are numerous; on the Carolina coast the tides have sufficient strength to keep large channels open. On the Texas coast line, north of the Rio Grande, there is a continuous stretch of 110 miles of barrier beach unbroken by a water channel.

Inlets through barrier beaches may be filled or completely obliterated by shifting mud flats, and where the shore currents are strong and well established there is the additional danger of destruction by shore drift. The difficulty of constructing satisfactory havens on a barrier-beach coast has often made such shores practically harborless.

25. Examples of shore work. The action of waves, tides, currents, and winds on the shore line may be illustrated by the coast of Cape Cod

(fig. 2). The outer end of the cape is a curved spit, and from Highhead westward it is composed entirely of sand, which has been carried thither by currents and distributed by the wind. The part of the cape from Highhead to the mainland is composed of unconsolidated sediment, largely glacial.

The process of work on the cape is as follows: Waves beating on the coast at and south of Highland light tear down the unconsolidated shore at a rate of about 50 feet per century. The prevailing currents of wave and tide run northward, and material quarried from the shore, and ground fine by the waves on the beach, is carried to Race Point. There currents running southward and later southeastward build the sand into a curved spit inclosing the harbor of Provincetown. The

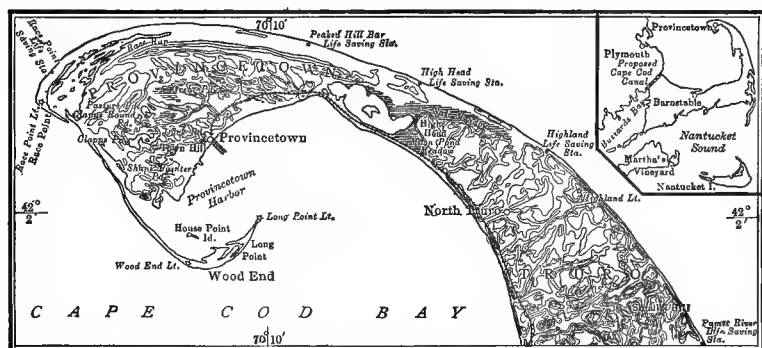


FIG. 2. Map of Provincetown Harbor

Scale, 1 inch = $3\frac{1}{4}$ miles; contour interval, 20 feet

great deposits of sand extending from Highhead westward were represented first by a spit beginning at the old land north of Highland light. The extension of the spit was the work of currents, but at low tide the beach sands came within range of the wind, and dunes were developed which, drifting westward, recovered the land from the sea. The dunes are still traveling, filling water bodies back of Provincetown and burying vegetation, and the currents continue to carry the sand on to the spit at Long Point. Artificial protection for the villages on the cape has not been entirely successful in stopping the development of sand bars or the migration of dunes.

Cape Cod is thus seen to be an example of what is occurring on all coast lines where sand is exposed to the action of currents and winds. Waves furnish the material, currents transport it, and the wind serves to build it into land permanently above high water.

TYPES OF HARBORS

26. Introductory. Harbors are first of all refuges for ships,—places where they may lie safely at anchor, be loaded and unloaded. They require, therefore, (1) sufficient depth of water leading from the open sea to the anchorage; (2) protection from waves. Without these features they are not adapted to man's use; but a thoroughly satisfactory natural harbor requires, in addition, (3) an anchorage ground large enough for many ships; (4) a fairly straight channel without strong currents; (5) relative freedom from shifting sand; (6) exemption from closure by ice. Commercial harbors are, however, more than this; they are terminal ports where inland and ocean commerce meet. They must have, therefore, (7) convenient access to the interior by available routes, or a location at the crossing of great highways of trade.

The absence of any one of these conditions may affect the value of a harbor otherwise satisfactory. For instance, Vladivostock, although possessing many characteristics of a good harbor, is closed by ice during a large part of the year. On the other hand, Valetta has a larger harbor than Malta requires, and Trincomalee, Ceylon, though an excellent natural harbor, is available only for naval purposes because of the absence of trade and back-country.

27. The places most suitable for harbors on the coast lines of the world are (1) drowned valleys, (2) barrier beaches, (3) rivers, (4) atolls, (5) craters.

28. Drowned-valley harbors. Drowned-valley harbors owe their existence to the fact that the coast line has sunk, allowing sea water to enter a river valley. If such a coast line is bordered by a plain, the sinking of the shore produces harbors like those of Norfolk, Baltimore, and Buenos Ayres. Depression of a more uneven land surface produces harbors like those of Rio de Janeiro, New York, those on the Maine coast, and Vancouver and Seattle on the Pacific coast. The drowning of a valley in a mountainous region produces fiords in which harbors may be located, as at Trondhjem on the Norwegian coast. Occasionally a range of hills or mountains is depressed to such an extent that sea water has access to a valley back of the range, and a former mountain pass becomes a harbor gateway, as at San Francisco.

Drowned-valley harbors have a depth of water determined by the amount of sinking the coast line has undergone. They are well protected from waves and have the advantage of easy access to the interior of the country, either by the rivers themselves or by railroads

along the valleys. The outlet to the sea, however, may be unsatisfactory; tides and currents may be difficult to control, and the drifting sands at the river mouths demand constant attention. The harbors of New York and San Francisco are examples of this type.

The present distribution of salt water in the neighborhood of New York is in accordance with the previous topography (fig. 3). North River and East River were valleys on the old land, the former being traceable for a hundred miles out into the Atlantic. The flatter depressions of the ancient land surface are now represented by Newark Bay, Upper New York Bay, and Raritan Bay, and the minor elevations in the old land surface are still visible as islands. The lower Hudson has sunk so much that a good depth of water is furnished at New York. The access to this deep water from the Atlantic, however, is impeded by drifting sand. The shore currents of wave and tide run westward on the south side of Long Island and northward on the east side of New Jersey; Coney Island and Sandy Hook are being extended, and sand is thus carried directly into the mouth of the harbor. Quantities of shore drift are piled up about the harbor's mouth in the form of shoals, and if these shore currents alone were at work, the bay would be completely walled in by embankments of sand. In spite of the tidal wash and the sinking coast (§ 22) the sand is slowly filling the harbor entrance. The outlet to the sea is kept open by the waters from Hudson River and from Long Island Sound, together with the scour from the tides which enter the bay directly, and so effective are these forces in offsetting the drifting sands that a natural depth of 18 to 20 feet is maintained, a condition found in few other ports. Ships drawing less than 18 feet of water pass directly into the bay through South Channel and Swash Channel (see fig. 3), but most of the shipping enters the harbor through two channels, largely artificial. The entrance for larger ships has long been through Gedney Channel and its continuation, Main Channel, which in 1883 had a depth of 23 feet at mean low water and was later deepened until a depth of 30 feet at low water is maintained for the 22 miles from the Battery to the Atlantic. This depth is not sufficient for modern commerce, and, furthermore, the channel was so narrow that ships over 600 feet in length could take the sharp turns only with great danger. The Ambrose Channel, with a depth of 40 feet and a width of 2000 feet, is therefore being constructed. This channel, which required 7 miles of dredging, was buoyed for navigation in September, 1907, and at the present time about four fifths of its length has been cut to a depth of 37 feet.

The position of New York and the character of its harbor accounts for its commercial supremacy. Access to the interior of the continent is easy, the tributary country is large, and the harbor has 100 miles of water front available for anchorage. There is already 90 miles of frontage along the docks and piers on the New Jersey and New York shores, which take care of two thirds of the foreign commerce of the United States.

The drowning of the coast at San Francisco (fig. 4) has admitted the sea to the Sacramento valley, which, combined with the San Joaquin, makes the great valley of California (§ 68). The shoaling bottoms bordering on the eastern part of the bay make the protected edge of San Francisco peninsula the natural location for piers

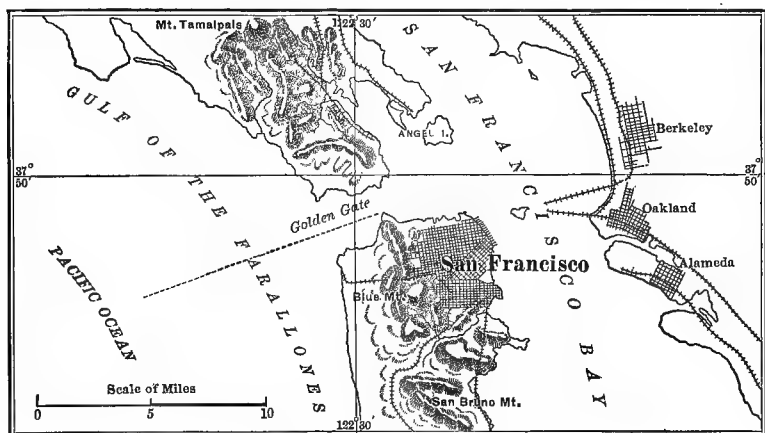


FIG. 4. San Francisco Harbor

29. Barrier harbors. Wave and tidal currents, which have developed barrier beaches (§ 24), bars, spits, and hooks along a large part of the world's coast line, form inlets through these barriers and thereby furnish access to quiet-water anchorage back of the ridges of sand. Such are the harbors at Provincetown (§ 25), at Galveston and other points on the Gulf coast, at many small cities on the Carolina, Florida, and New Jersey coasts, and such also are the harbors at Danzig, Germany, and the African port of Durban. A constant movement of sand along the shore and back and forth through the inlets makes the maintenance of a permanent channel in a harbor of this type a matter of great difficulty. Inlets change their position in spite of engineering works, and attempts to make harbors though barrier beaches often result in failure after the expenditure of millions of dollars. On

certain coast lines the presence of continental islands replaces barrier beaches and furnishes quiet-water anchorage. Boston harbor, although belonging to the drowned-valley class, owes much of its value to the fact that it is protected by a number of islands which, in turn, must be protected from the waves of the sea; and Callao owes its importance as a seaport in part to the presence of nearshore islands, back of which ships may ride in comparative safety.

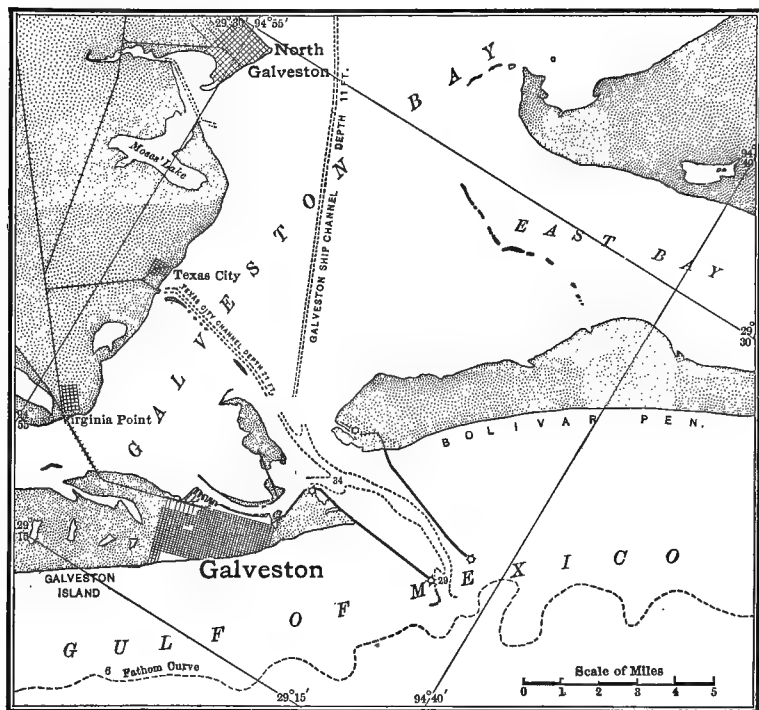


FIG. 5. Galveston Harbor

Barrier harbors have easy lines of access to the interior, for they lie on the margins of flat coastal plains, upon whose edges barrier beaches are more fully developed than in the case of a more complicated topography. They are well protected from storms. The depth of water, however, is never great, and often markedly fluctuating. The characteristics of barrier harbors may be illustrated by those of Galveston (fig. 5) and Cette (fig. 9).

Galveston lies at the end of a sand island (barrier beach) 30 miles long by $1\frac{1}{2}$ to 3 miles wide. The natural wash of tide and current

through the inlet between Galveston and Bolivar peninsula has been increased by jetties until 18 feet of water, together with a satisfactory anchorage, have been secured. The land on which the city rests was originally so low as to be flooded in times of storm. An extensive tributary country and a location on the Gulf give Galveston commercial importance and justify the great expense involved in raising the entire island and rebuilding the city after the hurricane of 1900 (§ 7).

30. River harbors. Many large harbors of the world, such as those of New Orleans and Hamburg, are located some distance up rivers (§ 14). Such harbors have convenient access to interior commerce, allowing commodities to be brought some distance inland without transshipment, and they may be so located as to form a common center for shipping and agriculture. Their protection from waves is ample, and most of the other conditions of harbor location are fulfilled. The depth of water is also usually ample in the harbor itself, but the presence of deltas (§ 45) makes it difficult to maintain a satisfactory depth of water across the bar because some of the largest rivers of the world have but a few feet of water at their mouths. Thus the Volga, which has a navigable water way of about 7500 miles, has a depth of barely 8 feet over the bar at its mouth. So valuable, however, are river harbors that much attention has been given to means for deepening the channels across the deltas. To this end jetties have been put into the Mississippi, the Danube, and numerous other streams. The Thames has been deepened to Tillbury, and the Po has been confined for centuries between artificial embankments. Scarcely a large river of the German Empire flows in its natural channel. If the harbor is located on the delta itself, an additional disadvantage is present, namely, that the main current may change, shifting its position in a very capricious manner. The outlet of the Hwang-ho, in 1888, was 300 miles from its present mouth, and its frequent change of position has caused enormous destruction of life and property (§ 45). Typical river harbors are the ports of New Orleans (fig. 6), Portland (Oregon), Shanghai, and Calcutta.

The Mississippi at New Orleans has a depth of water ample for the largest steamships, and its navigable water connection with fifteen states makes its location of great commercial importance. However, in spite of its great length and volume, the Mississippi had, in a natural state, a navigable depth over the delta of but 8 to 13 feet, a depth altogether inadequate for modern commerce. To remedy this defect Captain Eads contracted, in 1875, to secure 30 feet of water way by a system of jetties, which was designed to force the stream to remove

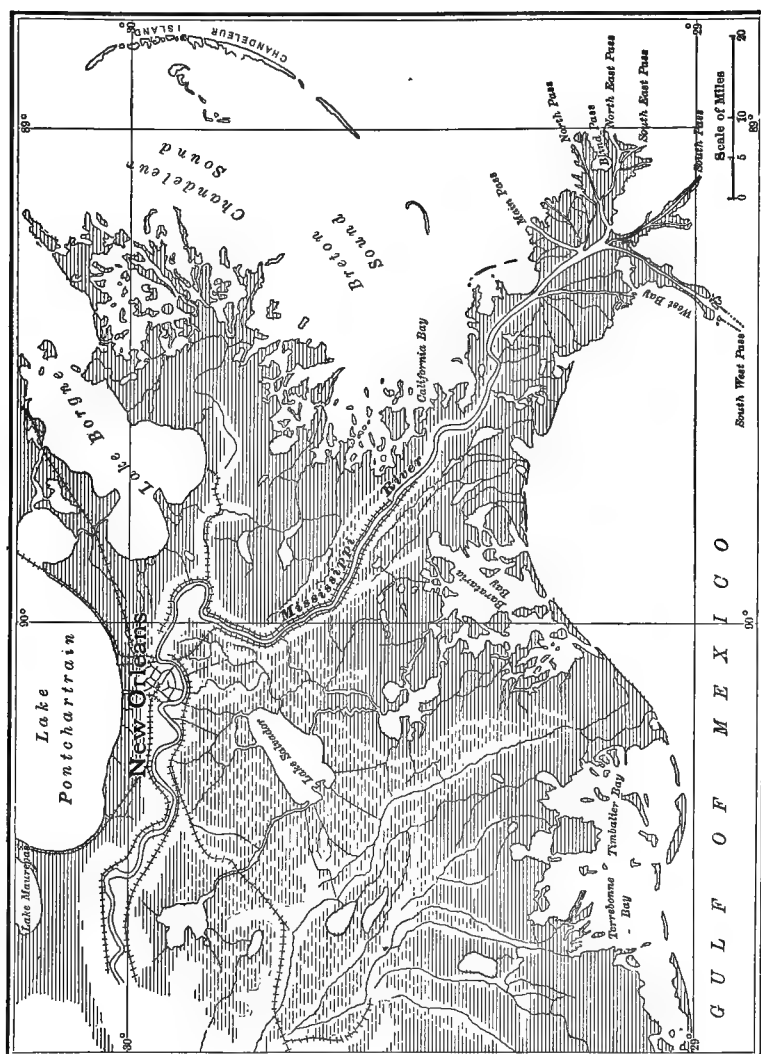


FIG. 6. New Orleans Harbor

the sediment from its own bed. In this attempt he was successful, and for thirty years South Pass has been the commercial entrance to New Orleans. The new jetties in the Southwest Pass will secure even greater depth of water and will shorten the route to Panama and Central America.

It is desirable that a Pacific coast port be located at some place on the lower Columbia River, for access to the interior by way of this

great river and its tributaries is better than by any other route eastward from the Pacific. Appropriations have been made for the construction of a 40-foot channel across the bar at the mouth of the Columbia, with the idea that further dredging and training of the stream will produce a satisfactory harbor at Portland, 110 miles from the sea.

31. Coral-reef harbors. Coral reefs, built by polyyps where conditions of temperature are satisfactory, form excellent quiet-water anchorages, particularly when the reef has the atoll form, — a ring of coral breached at certain points. The commercial value of atoll harbors is slight because of the lack of territory on which to draw and

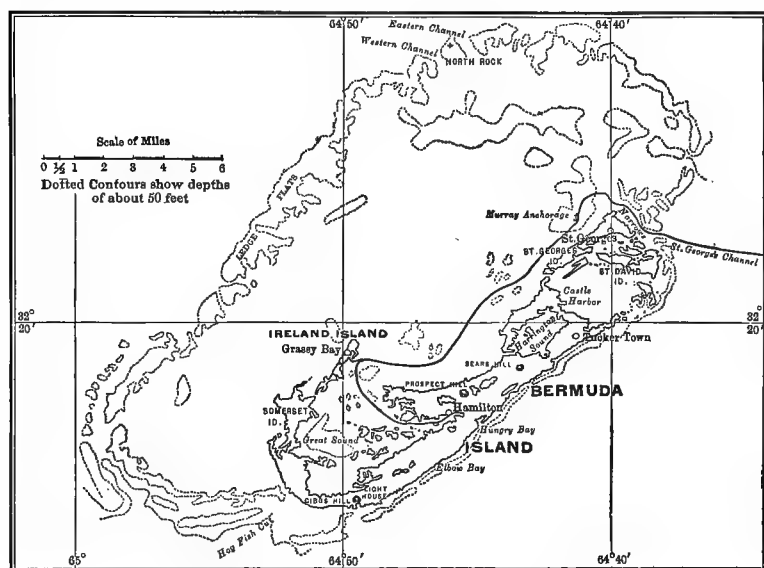


FIG. 7. Ireland Island Harbor, Bermuda

the great distances from large land masses, but they have wide use as havens of rest or stations of transshipment along great sailing routes, as at Suva (Fiji Islands). Irregular growths of corals in the open ocean or near shore have, however, furnished a number of valuable ports. Key West is formed of coral; and the harbor of Ireland Island, Bermuda, which is the central Atlantic station for the British fleet, is composed entirely of coral. The entrance to this harbor is by a long tortuous channel through ancient reefs (fig. 7).

32. Crater harbors. Submerged volcanoes, breached so as to allow access of sea water, may possess many natural advantages. Lyttelton, New Zealand, which is the port of Christchurch and the gateway to

the rich Canterbury plains, is a harbor located in an old crater. Goods are transferred from Lyttelton to Christchurch by an inclined railway built in a tunnel through the wall of the ancient volcano. Aden is another example of harbors of this type.

33. Artificial harbors. On coast lines where no natural harbors exist it is possible to build them at great expense by constructing



FIG. 8. San Pedro Harbor

works which take into account the normal action of the ocean. If the height of the waves is not too great, nor the tidal currents too strong, the harbor thus constructed may possess the advantages of a natural anchorage. The expense, however, is always enormous, and the permanency of the structures uncertain (cf. §§ 190, 192). Many small undertakings of this sort have resulted disastrously, and even the resources of

Chile have not been suffi-

cient to build a satisfactory harbor off the unprotected coast of Valparaiso, owing to the condition of the bottom and the enormous expense involved. Successful attempts to construct harbors of this type may be illustrated by the harbors of Algiers and San Pedro (fig. 8). A harbor has been constructed at this latter point because Los Angeles demanded an ocean outlet. San Pedro was chosen because it is the best of a number of poor sites. The absence of favorable natural conditions is indicated by the fact that one of the artificial breakwaters at San Pedro reaches the remarkable length of 9000 feet and cost nearly \$4,000,000.

Though chosen primarily for their natural advantages, most harbors are artificial to a greater or less extent, and the method of improvement is usually to build jetties, which tend to confine the water and make it scour deeper, or to dredge in order to increase the depth of the channels, or to build breakwaters, which are designed to give protection from the waves and at the same time control the currents

which are carrying sand into the harbor mouths. Harbors at river mouths are the most easily dredged and protected, and here the method is usually to increase the effectiveness of the scouring by rivers and tides. In this manner the mouths of some small streams have been made important harbors. The Clyde River, for instance, is a stream of no great importance and contained originally only 2 to 3 feet of water. By proper dredging and building of protective works sufficient depth has been secured to make Glasgow a shipping center of great importance.

VALUE OF HARBORS

34. The relation of harbors to coast lines and the commercial importance of a good location may be illustrated by the following instances. On the south coast of France the natural line of access to

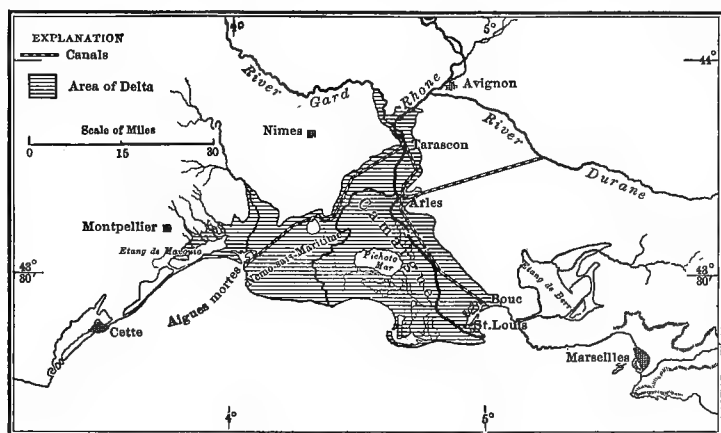


FIG. 9. Delta of the Rhone

the interior is the Rhone (fig. 9). This river, however, depositing large quantities of sediment in a tideless sea, builds an extensive delta on which the water is shallow and the position of its channels uncertain. In spite of the expenditure of millions of dollars and the efforts of the ablest engineers, the river has not been made navigable for ships of large size, and Port St. Louis, at the mouth of the Rhone, is rarely shown on atlas maps. The port of Cette, on this coast, is located near an inlet between two sections of a barrier beach, where a sufficient depth of water is maintained with difficulty. Marseilles is the one natural port on the southern coast of France, and owes its preëminence to a depressed coast and to a shore line so shaped as to furnish protection

from the larger waves. Harbor works have increased the size and safety of the port until it has become one of the chief harbors on the

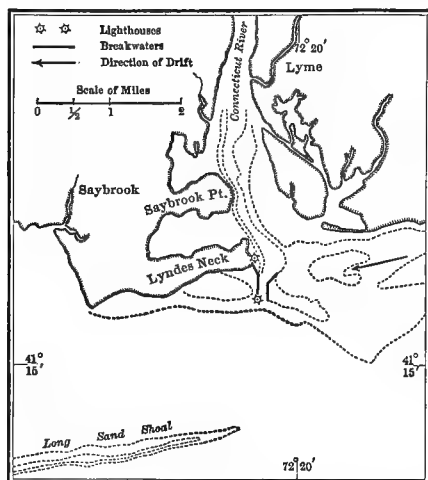


FIG. 10 a. Mouth of the Connecticut River and constantly shifting delta. The old port of Adria, which gave the name to the Adriatic Sea, is now 14 miles inland.

entire Mediterranean coast line. Access to the Rhone valley, which is the natural line of travel inland, is gained by constructing railroads from Marseilles to join the river above its delta.

In the Adriatic Sea similar conditions prevail. Trieste and Fiume are the terminations of important steamship lines, but the sand-fringed Italian shore furnishes no good harbors, and the great Po River, the natural line of entrance to Italy, is rendered useless by a rapidly growing

Two places on the west coast of the United States, Puget Sound and San Francisco Bay, possess natural harbor sites of high grade. Each owes its existence to the depression of ancient highlands, the Strait of Juan de Fuca as well as the Golden Gate being typical drowned valleys (§ 28). The Columbia River is blocked by bars (§ 24), and the long stretches from Astoria to San Francisco and from San Francisco to San Diego offer little opportunity for safe anchorage of ships. San Diego has a barrier harbor with 28 feet of water over the bar, and Los Angeles has, at great expense, constructed anchorage at San Pedro (§ 33). San Francisco stands preëminent on the Pacific coast because it is the only high-grade harbor between Tacoma and the Mexican border. New York, in the drowned valley

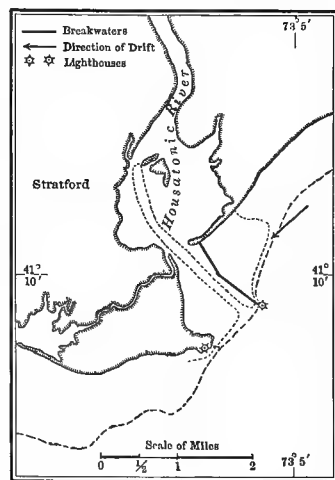


FIG. 10 b. Mouth of the Housatonic River

of the Hudson, possesses advantages unequalled by other Atlantic coast cities, and London, occupying the first high land inside of the Thames estuary, has become the commercial center of the world.

In the cases cited above, the character of the harbor has determined the importance of a seaport, and in certain places the presence of a harbor has controlled the location of a city in spite of evident disadvantages: thus Kingston is known to be in an earthquake zone; its harbor has been repeatedly damaged and is liable to be destroyed at any moment. The configuration of the Jamaica coast is such, however, that Kingston remains the only available harbor site.

The importance of tides and currents in relation to other conditions is well shown by three harbors of Long Island Sound (figs. 10 *a*, *b*, *c*). The natural lines of access to the interior are the large rivers, the Connecticut and Housatonic, and it would be highly desirable if harbors could be located at their mouths. The Connecticut, however, though one of the largest rivers of New England, has its mouth so blocked with sand as to leave a natural depth of only 7 feet. The Housatonic, a stream 100 miles long, has a normal depth over the bar of only 3 feet. New Haven harbor, which furnishes an outlet for three little rivers, the longest of which is only 35 miles, has a natural depth of nearly 20 feet of water. The difference in value of these harbors is due to the shape of the drowned coast line and the fact that the shore currents of Long Island Sound run westward. At the Connecticut River, Lyndes Neck is so located as to allow the sand to drift into the river's mouth. The mouth of the Housatonic is even more unfavorably placed, for the river turns squarely into the face of the drifting sands. At New Haven, on the other hand, the eastern cape, Lighthouse Point, projects in such a way as to lead the westerly drifting sand into deep water.

From what has been said it is clear that the location, development, and commercial importance of coast cities, large and small, are inseparably bound up with the alignment and structure of the coast.

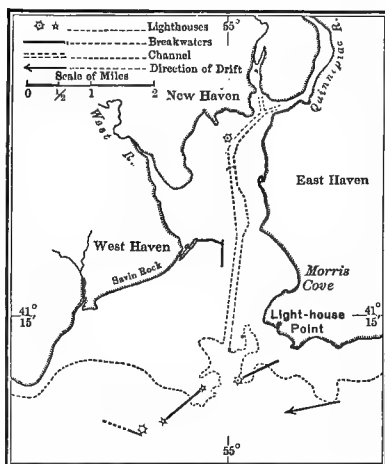


FIG. 10 *c*. New Haven Harbor

CHAPTER II

TOPOGRAPHY

GENERAL RELATIONS

35. Introduction. That the shape of the earth's surface has exerted a controlling influence on human history and economic development is almost self-evident. Cities are not located in haphazard fashion, but at points where, among other things, the topography is favorable. Railroads follow predetermined courses. Mountains present difficulties to settlement and transportation (§ 296); plains constitute the great farms of the world. Parts of the earth are entirely removed from settlement because of unfavorable topographic form, and the migrations of people have been directed and in large part determined by the relief of the land (§§ 162, 166). The water bodies of the world are not habitable, and if we add to them the regions which are too high or too low for settlement and those affected by adverse climate, there remains scarcely one tenth of the earth's surface which is suitable for the home of man.

36. Topographic changes. Topographic features are not to be considered permanent; hills, valleys, plains, and other recognized forms of natural scenery have undergone changes within historical as well as geological time. Mountains have not always occupied their present position, and sea and land have sometimes changed places. In a previous age the edge of the North American continent was 110 miles beyond New York City, and rivers flowed across Long Island Sound, emptying into the ocean to the south. In recent geological times the Strait of Gibraltar was closed and the Mediterranean joined to the Red Sea. England was part of the European continent, and the Black and Caspian seas formed part of a great water body extending east of the Urals to the Arctic Ocean. Ostia, the ancient port of Rome, is now over a mile inland. The Niagara River has cut a gorge 7 miles long since glacial time. At one period lakes and waterfalls were as unusual in New York and New England as they are now in the southern states. Buildings erected three or four hundred years ago on the west coast of Greenland are now under the sea, and a Spanish warehouse built two centuries ago near the mouth of the Mississippi is partly under water. The San Francisco earthquake (1906) resulted in

moving a large part of California 8 feet farther north. Even the everyday quiet action of water and frost and air on the land is continually modifying its topography. Mountains are reduced to plains by slowly acting forces, valleys are cut out of solid rock, deltas are built, and hills of great variety are continually in process of development. A few of these changes occur suddenly, within a few minutes, but most of them require thousands and some require millions of years. During the lifetime of an individual the scenery changes only an inappreciable amount, but the modification is along definite lines and may be readily interpreted. For a proper appreciation of the world about us it is necessary to recognize the fact that development and evolution, not permanency and stability, characterize land forms.

37. Area and height of lands. The waters covering the earth are so great in extent that a relatively small proportion of land is exposed permanently above the water surface; in fact, the land of the world might well be considered as those parts of the earth's surface not drowned by the oceans. The entire area of the globe is about 197,000,000 square miles, and of this amount the lands constitute a little over 50,000,000 square miles, — about one fourth of the earth's surface.

A physical map of the world shows that six sevenths of all the land is more or less connected in one so-called "land hemisphere," and that the remaining areas constitute about one thirtieth of the earth's surface. For convenience the surface of the land is divided into continents, which are simply large land areas, each possessing more or less distinct physical characteristics. In Europe 54 per cent of the land is less than 600 feet above the sea and only 10 per cent is above 6000 feet. Extensive low plains characterize this continent. Africa has $87\frac{1}{2}$ per cent of its surface over 600 feet above the sea, and thus extensive plateaus are its predominant feature. Australia is much like Africa. Asia contains immense plains and is characterized also by massiveness and the height of its mountain ranges. Thirty-eight per cent of this continent lies above 3000 feet and its average height, 2884 feet, is greater than that of any other grand division. North America and South America are built on much the same plan; they have long, narrow mountain ranges, with extensive plains and plateaus. The Rocky Mountains and the Andes are, however, not to be considered as a continuous chain, the northern Andes terminating at the coast of Colombia; a distinct mountain system, including Central America and the West Indies, separates the Andes from the North American Pacific mountain system, terminating in southern Mexico.

Considered as a whole, the height of land above sea level is much less than the depth below it. The deepest depression (31,614 feet) exceeds the highest point, Mt. Everest (29,002 feet), and the average elevation of the land is less than half a mile above sea level (about 2300 feet), while the average depth of the sea is more than 2 miles (about 12,000 feet). Parts of the land surface lie below the sea level; the largest of such depressions is the Caspian Sea district and the deepest is the Dead Sea (1300 feet). If all the lands now above the sea were thrown into the ocean depths, so as to obtain a uniform level, the entire earth would be covered with water $1\frac{1}{2}$ miles deep.

To mankind these profound depths and great heights are very impressive, yet, relatively to the earth's diameter (8000 miles), they are insignificant. The extreme difference in relief between the greatest ocean depth and the top of the highest mountain, about 11 miles, would be represented on an 8-inch globe by a very thin coat of varnish. Nevertheless, the topography of the surface is one of the controlling factors in producing climate, which in turn determines in part the distribution and habits of living forms.

38. Kinds of rocks. The rocks of the earth are of several hundred different kinds, composed of over twelve hundred mineral species, varying greatly in composition, structure, and in their ability to resist erosion. As articles of commerce they include the ores¹ and a large part of our building material and fuel, and in their decomposed state form the soils of the world (Chapter III). As material out of which the earth is built, they fall readily into three great groups:

1. Those which solidified from a molten state are the so-called *igneous* rocks. The solidification may have taken place beneath the earth's surface, or on the surface, as lava and other products of volcanoes. *Granite* (§ 267) is an illustration of this type and is composed entirely of crystallized fragments, chiefly quartz, feldspar, and mica. These crystals are closely bound together, and it is only after its weakest mineral, usually feldspar, is weathered out that the rock begins to crumble into soil. Rocks of this class rank high for building and monumental purposes.

2. The decomposition of rocks furnishes material which, when redeposited by water or ice or wind, constitutes sedimentary rocks; these consist of grains or fragments of different sizes united by a cement and arranged in strata originally in a horizontal position.

¹ Nothing is said in the present connection with reference to the distribution of ores; there are no simple principles that govern this matter, and the actual distribution is treated sufficiently in Part III (§§ 254-268).

Sandstone is a type of this class and consists chiefly of grains of quartz held together by lime or iron. *Limestone*, another member of this group, is composed of lime, furnished in large part by shells of extinct organisms; while *shale* is a sedimentary rock which consists of compacted muds and silts of ancient seas and lakes and rivers. Sandstone and limestone are more extensively used for structural purposes than any other rock type.

3. Igneous or sedimentary rocks which have been buried deeply in the earth, and crushed, stretched, and squeezed so as to bear little resemblance to their original form, are called *metamorphic*. To this group belong the gneisses, schists, slates, and marbles (cf. § 267), which have large commercial value.

39. Weathering. While the ocean bottom is a place of quiet where rock formation and rock decay are excessively slow, the lands, on the other hand, are marked by activity and continuous change, due to physical agencies and to life. The surface rocks are split by frost, decomposed by the atmosphere and by plant life, ground up under ice, reduced to dust by rivers and waves, and carried about by winds, streams, and currents. The result is the formation of a mantle of decomposed rock waste, spread loosely over the lands. The general process of change from firm rock to unconsolidated soil is *weathering*, and its nature may be readily appreciated by comparing a stone fresh from the quarry with one in an ancient wall or with an old monument in a cemetery. Rocks decay at varying rates, depending upon their composition and the activity of the eroding agent. The "softer" rocks are removed first, the "harder" ones later; and accordingly the less resistant rocks are represented topographically by valleys, while the more resistant ones stand as hills and ridges.

TYPES OF LAND FORMS

40. The minor topographic features of lake, waterfall, pass, or canyon exert a direct influence on the location of cities and the development of transportation. In a larger way the fundamental land forms represented on the earth have controlled settlement, directed migration, and determined the location of fertile tracts and the position of the world's inland markets.

Plains, valleys, mountains, and plateaus are the chief topographic forms of world-wide influence, and, where typically developed, they present features which are individual and which may readily be recognized. There are, however, no sharp lines of demarcation between

the various kinds of land forms, and no uniform nomenclature exists. A so-called plain in an interior region may be similar to a plateau near the sea; mountains grade into hills and these into plains and plateaus of uneven surfaces; valleys grade into plains, and plateaus into mountains, — a condition which is readily understood if we bear in mind that any given topographic form is merely a stage in a long process of development. The first type of land forms which requires consideration is plains.

PLAINS

41. Introductory. Any flat-lying area of land constitutes a plain. It may include a few acres or may constitute a large part of a continent; the material of which it is composed may be unconsolidated sands or gravels or clay or solid rock; its flat surface may be due to horizontal strata or to the erosion of mountains of complicated structure.

Plains are favorable for agriculture; they present an easily tilled soil and few obstacles to transportation, and accordingly have become the home of 90 per cent of the world's population. The plains and harbors of Europe and America are prominent factors in the commercial supremacy of these sections of the world. The chief disadvantage of the plain is the absence of mineral products. Stone for building does not occur in the great agricultural districts of Russia, Hungary, South America, and Holland, nor generally on the plains of the world.

42. Terraces. A widely distributed form of plain is the river terrace, seen along streams and valleys where, for any reason, a river which formerly deposited material begins to remove it; or where a broad stream is confined to a narrow channel, cutting deeply into the sediment already laid down. The result of such action is to develop on the valley sides long and narrow strips of flat land, which have become favorite places for the location of cities. Springfield, Massachusetts, stands on a terrace of the Connecticut River, and London is located on a terrace of the Thames.¹

43. Lake beds. A second type of plain marks the site of former lakes (§ 91). Small plains of this sort constitute choice farming sections throughout the north temperate zone and may be observed in most of the states north of the limit of ancient glaciation (see fig. 15). One such lake bed has been an important factor in the economic history of North America, since it has given rise to the

¹ Marr, *The Scientific Study of Scenery*, p. 235.

famous wheat lands of Minnesota, Dakota (§ 218), and Manitoba, a region formerly occupied by a body of fresh water (Lake Agassiz) whose remnants stand as Lakes Winnipeg, Winnipegosis, and Manitoba.

44. Flood plains. The lands over which a river may spread in times of flood, and which, under natural conditions, are entirely within the control of the stream, constitute *flood plains*. They are best developed by rivers of large size which flow through regions of unconsolidated rock and whose drainage basins are subject to a fluctuating rainfall. In form these plains are highest adjoining the channel, and the only parts normally above high water are the two narrow belts of land which form the river's banks. The stream appears to have intrenched itself in the top of an embankment, which may stand 10 to 20 feet above the bordering swamp. The building of these barriers along the river's course makes it impossible for the tributaries to enter normally, and they accordingly are forced to run parallel to the main stream for considerable distances; thus the Yazoo travels 200 miles and the St. Francis 100 miles before they are able to enter their master stream, and the Atchafalaya, which would naturally be a tributary to the Mississippi, follows an independent course to the Gulf.¹

Flood plains are built up of annual or seasonal accretions of sediment and their soil is accordingly of fine texture.² This fact and ease of transportation are the two commercial advantages possessed by plains of this type; and so fundamental are these features that where climatic conditions are favorable, — as in the valleys of the Po, the upper Ganges, the Nile, and the Hwang-ho, — flood plains become the most densely populated sections of the world; the same is true, in less degree, of the Volga, the Guadalquivir, the Paraná, and the Theiss. The flood plains of the Mackenzie, the Ob, and the Lena are of little value to man because of the severity of arctic climates, while the Euphrates, Oxus, and Lower Colorado are examples of plains in districts too arid for ordinary agriculture.

The flood plain of the Mississippi is a typical example of this class of land forms. This river has a water discharge greater than the Po, the Danube, and the Rhone combined, and carries annually some 400,000,000 tons of sediment to the Gulf of Mexico. Its high-water stage is 50 feet above low water. The portion of its valley

¹ These features of the Mississippi drainage system are represented on all good maps of this region (see also fig. 6).

² Each inundation of the Nile leaves a layer of fertilizing silt .03 inch thick.

subject to flood is 29,700 square miles, extending from Cape Girardeau to the Gulf, a direct distance of 600 miles, which becomes 1125 miles when measured along the meandering river. The Mississippi changes its channel so abruptly and extensively that almost every year the steamship routes must be relocated and boundary lines reestablished. Even villages must fight for their existence. Kaskaskia, the capital of Illinois until 1819, was changed into an island in 1881, and entirely destroyed by floods in 1899. In Greenville, a port of 8000 inhabitants, the houses on the river front are being continually shifted to the back of the town, and the city is apparently marked for destruction. The same conditions hold along the Missouri, where there is an annual transfer of property between Nebraska and Iowa, Kansas and Missouri, and where one of the chief cities, St. Joseph, is waging a losing battle with the treacherous stream.

The efforts to control the Mississippi have been only partially successful.¹ Fifteen hundred miles of levees have been constructed, bringing 75 per cent of the stream under control; but the river still exhibits its power, and thousands of acres were inundated during the years 1881, 1882, 1884, 1897, 1903, and later. By careful, continuous, and very expensive levee building the number of crevasses has been reduced from 284 in 1882, 23 in 1890, and 49 in 1897, to 9 in 1903. Relying on these artificial embankments, settlements have increased in the side valleys; the Yazoo basin, for instance, somewhat larger than Connecticut and Rhode Island combined, contained at the last census a population of 195,000, an increase of 100 per cent in twenty years. Yet during the high water of 1903 one quarter of this basin was under water and one half of the city of Greenville inundated; traffic was suspended for twenty days, and one third of the inhabitants (65,000) were driven from their homes. And even with the best of levee protection cities located on the river have unique problems to solve. Thus in New Orleans the domestic water supply is largely rains, and the old cemeteries are constructed of masonry above ground. The city cannot empty its sewage into the Mississippi because the houses are below the top of the river's banks and storm water runs not toward the river but back through the streets to the adjoining swamps (fig. 6). Under such conditions it is not surprising that the construction of an adequate sewerage system was so long delayed and that, as a result, the history of the city is marred by a succession of epidemics.

¹ Brown, "Protection of the Alluvial Basin of the Mississippi," *Pop. Sci. Mo.*, September, 1906.

In spite of evident disadvantages the soil, climate, and especially the location of the Mississippi flood plain are so favorable that various plans for a great inland water way along the Mississippi valley have been presented. Those which give greatest promise of success are the following :

1. To give the river an entirely new course free from bends. This scheme has been successfully carried out in the cases of the Main, the Elbe, the Seine, and parts of the Ohio, but in the case of the Mississippi it would be an enormously expensive operation and one of doubtful success.

2. The construction of artificial outlet channels leading directly to the Gulf, which, if sufficient in number, would be effective; destroying, however, a large amount of arable land and defeating one of the chief objects of river control, namely, the protection of plantations on the river bottoms.

3. Building a series of reservoirs at the head waters of the chief tributaries, where the floods could be controlled and a uniform amount of water maintained in the main stream. This third plan is feasible and probably the most certain and least expensive.

45. Deltas. Much of the sediment of rivers is deposited along their courses as sand bars and flood plains, but much also reaches the sea or inland water bodies, accumulating at river mouths in the form of widespread plains or deltas, submerged or partly exposed above water level. In large rivers deltas are the continuation of flood plains and possess much the same characteristics as deposits farther inland. They vary in size from minute, fanlike structures to enormous expanses, capable of supporting millions of people. The Nile delta is 90 miles wide by 180 miles long. The Ganges delta has a front of 220 miles and extends 200 miles inland. The Orinoco delta has an area of 7000 square miles (larger than New Jersey). The deposit at Calcutta is at least 500 feet deep, and a well sunk at New Orleans brought up driftwood from a depth of 1042 feet. The Rhine, whose delta is 80 miles long, together with the Meuse, the Sambre, and the Scheldt, forms the great plain of the Netherlands. The head of the Adriatic is fringed by delta deposits, which have grown from 2 to 20 miles since the time of Augustus ; and Ravenna, originally on a lagoon like Venice, is now 4 miles inland. Where deltas emerge as a result of deposition or coast elevation they furnish arable land of extreme fertility and ease of cultivation. Two thirds of the Mississippi delta (12,300 square miles,—7,872,000 acres) is above water at its ordinary level and is growing seaward at the rate of one mile in sixteen

years. It is covered with plantations of sugar, rice, cotton, and cypress excellent for lumber (fig. 6). The delta of the Hwang-ho — "China's sorrow" — extends 400 miles along the coast and 300 miles inland (see map, fig. 11). It is extremely fertile and densely populated (over 800 per square mile). The river which forms this delta is so changeable that it is useless for navigation, and its waters are restrained only by an elaborate system of dikes and canals of great length. The first complete abandonment of its channel is supposed to have been in 2293 B.C., the second in 602 B.C. Since then

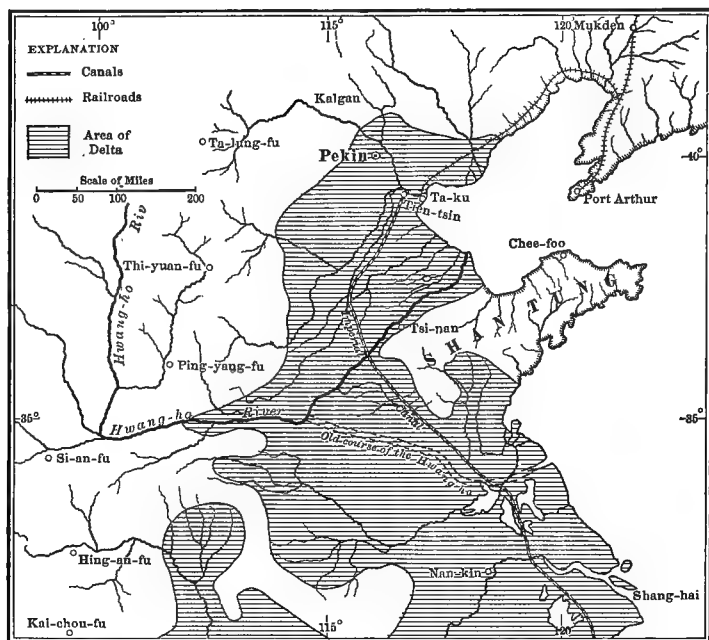


FIG. 11. Delta of the Hwang-ho

the river has changed its course many times by reason of increasingly frequent floods and of the fact that less care has been taken to prevent them; and we find disastrous overflows recorded in 1820, 1858, and 1887. During the last inundation many villages were destroyed, completely or temporarily, and the loss of life through drowning and famine exceeded 1,200,000 people, considerably more than the entire population of West Virginia.

An illustration of the capriciousness of streams and of the difficulty of adapting deltas to the use of man is furnished by the Colorado River (fig. 12). The lower part of this stream has few branches for

300 miles. The supply of silt from the canyons and mountains of the upper basin amounts at times, however, to over a million tons per day; at Yuma, from September, 1903, to August, 1904, 95,000,000 tons were carried, and the silt transported annually is sufficient to

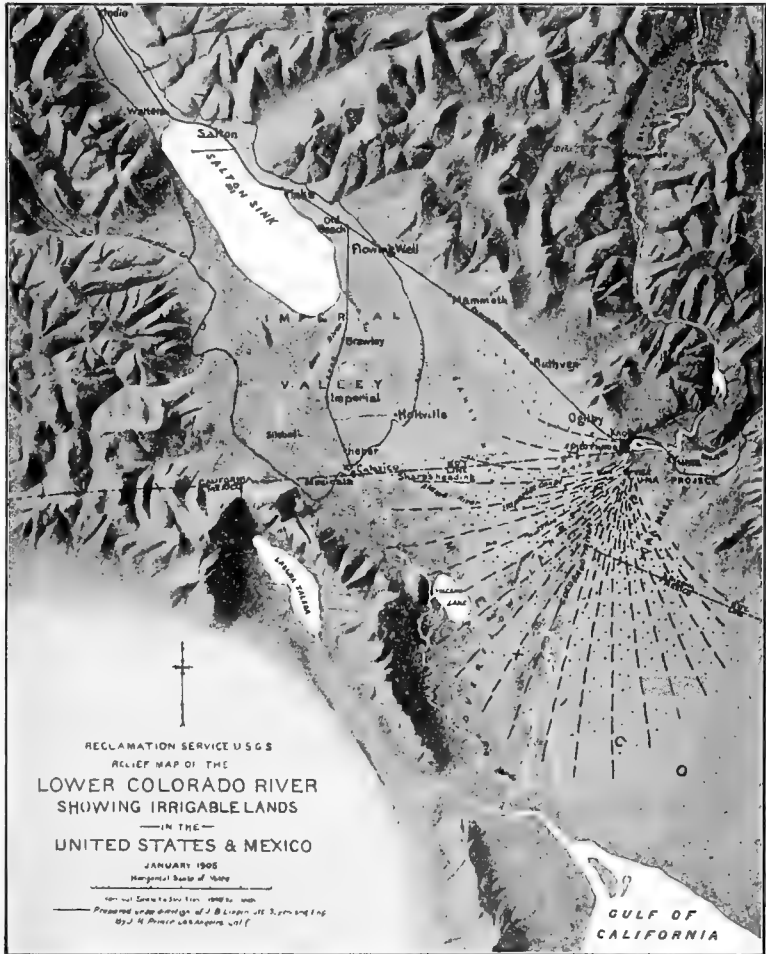


FIG. 12. Colorado Delta Region. (From the *National Geographic Magazine*)

Delta represented by broken radial lines

cover 53 square miles 1 foot deep with alluvium. Centuries ago the Gulf of California extended 150 miles farther west than now, to a point beyond Indio and up the present valley to Yuma. On the east side of this extension of the Gulf the Colorado built up a delta so

large that it reached the opposite side. North of it a salt-water lake was left completely detached from the Gulf,—a lake which has since been reduced by evaporation to the small Salton Sink. The soil in part of this depressed area of the old lake bed is favorable for agriculture, and the climate is unusually propitious for fruit growing. An effort to obtain water from the Colorado River for irrigation of the 1,000,000 acres of the Imperial valley (fig. 12) gave the stream an opportunity to regain its old channel on the north side of the delta. An 8-foot irrigation canal, constructed in October, 1904, was, by April of the following year, scoured out by the river to 100 feet and finally to over 300 feet in width. On June 30, 1905, 22 per cent of the river was passing through this canal, by July 8 this amount had increased to 67 per cent, and during the last week of October the river abandoned its old channel and took up the widened irrigating ditch for its regular route, thus discharging its water into the Salton Sink. Before the close of 1905 a lake had been formed 45 miles long, 10 to 18 miles wide, and 23 feet deep, and was rising at the rate of one half to three fourths of an inch daily. In 1906 arable land to the extent of 700,000 acres and 150 miles of railroad track in the Salton valley were in danger,¹ and when the region about Yuma and the government irrigation works were taken into account the possible loss was estimated at from \$350,000,000 to \$700,000,000.² Steps were immediately taken to force the river to regain its former channel. Dams built in the early part of 1906 were destroyed by the spring flood, and the heavy discharge of May, June, and July extended the river into the populated districts. Later a million-dollar plan was made for the construction of a new channel, and a 500-foot embankment was commenced, but by October practically the whole river was again flowing through the gates. On February 11, 1907, the break in the Lower Colorado was at last closed by the energy and persistence of the Southern Pacific Railway Company, backed by the United States government. A force of a thousand men working day and night, the resources of a great corporation and an appropriation of millions of dollars were necessary to prevent this river even temporarily from pursuing its ancient course.

46. Coastal plains. Elevation of the shore line (§ 2) results in increasing the continental areas by adding a fringe of land recovered from the sea. This new land is a coastal plain and in structure

¹ Eleven towns in southern California are from 22 to 265 feet below the level of the sea.

² Message of President Roosevelt, 1905.

possesses the characteristics associated with continental shelves, namely, a fairly uniform surface with seaward slope, the surface material consisting of sands, gravels, and silts. Such is the structure of the great coastal plain extending from New York to Florida, which may serve as a type for similar forms throughout the world. Delaware, parts of Maryland, and half of New Jersey are composed of stretches of sands and clays recently recovered from the sea. Farther south the same conditions prevail. The plain of Virginia, east of a line from Washington to Petersburg, is deeply incised by the bays, inlets, and creeks of the "tide-water country." In North Carolina this plain is 100 miles wide, increasing to 150 miles in South Carolina. So flat is the country and, in places, so low, that roads may extend long distances without bends and water may stand in swamps on the surface. "The Wilmington and Weldon Railroad has a stretch of 40 miles in which there is neither curve nor embankment."¹ The inner edge of the Atlantic coastal plain is indicated by a line of cities, which have been located in response to topographic control. Philadelphia, Baltimore, Wilmington, Washington, Richmond, Raleigh, Camden, Columbia, Augusta, etc., are located at the contact of the old land with the newly added plain. Such a location is favorable for manufacturing (§ 270) because of the presence of falls or rapids where the rivers leave the old hard rock and enter the soft material of the coastal plain; and also for commercial centers because of the necessity for transshipment of goods, and because the products of two unlike areas find here their natural center of exchange. A coastal plain may consist of parallel belts hundreds of square miles in extent, or of narrow fringes of land. The eastern coastal plain of Mexico, in the neighborhood of Vera Cruz, is 50 miles wide, and the eastern border of the uplands of India has about the same width. The Oregon plain, near Port Orford, is 1 to 5 miles wide. The great coastal plain of Argentina, on the other hand, has a width of over 100 and a length of over 1000 miles. The eastern part of England is an illustration of a coastal plain belonging to a geological age now long past.

Coastal plains offer certain special advantages for settlement. They possess a large extent of arable land, easily tilled; travel back and forth across them is not difficult; there is ready access to harbors; and owing to their underlying structure, artesian water may usually be obtained. On the other hand, harbors bordering coastal plains are often poor, and the soil covering the plain may be markedly deficient

¹ The Transandine Railroad extends for more than 200 miles across the coastal plain of Argentina in a straight line.

in plant food ; so while, in the aggregate, the coastal-plain population of the world is large, it is because the acreage of coastal plain is great rather than that conditions on these plains are favorable for supporting a large number on a small area.

47. Plains of denudation. All land above sea level is constantly being worn down by the atmosphere, winds, rain, rivers, glaciers, waves, shore currents, etc. These agencies cannot reduce the land surface below sea level, and the final result of their activity is therefore a more or less uniform surface with but little elevation above the sea. Level surfaces made in this manner are *plains of denudation* and are carved out of other land forms either by the action of the forces that work on the land or by the waves of the sea, and because of this method of origin they rarely show the uniformly level character exhibited by other plains, but instead are marked by residual hills and ridges of harder material rising somewhat above the general level.¹ Plains of denudation produced by weathering and removal of land surface are called *subaërial*, while those worn down by the gradual encroachment of waves are plains of *marine denudation*. Central Russia is an example of the former and narrow portions of southeast Africa of the latter.

Since plains of denudation are the result of erosion of mountains or plateaus or other elevated lands, their present surface often consists of rock which formerly was deep within the earth, and the soil covering is not the fine-textured and stratified sedimentary deposits of river and tide, but consists of rock masses more or less decomposed. The residual soils of the piedmont belt of Virginia and the blue-grass region of Kentucky, formed in the latter way, are widely different in origin, texture, composition, and productivity from the transported soils of southern Texas or the Missouri bottoms.

48. Alluvial plains. A sediment-laden stream deposits its load when its velocity is sufficiently decreased. This is observed in all streams, but is particularly noticeable where a valley is marked by abrupt change from high to low grade, for example, where a precipitous gorge opens upon a plain. This sudden loss of power compels the stream to deposit its burden of rock and silt at the point where the gorge joins the plain. Under normal conditions, in humid regions, the master stream is competent to remove the waste supplied by the tributaries. But if the supply is excessive, as in steep mountain valleys, or the main stream weakened, as in arid regions, an accumulation of waste is left at the river's mouth, — a half-conical pile with its base in

¹ Such a surface is also called a *peneplain* (that is, almost a plain).

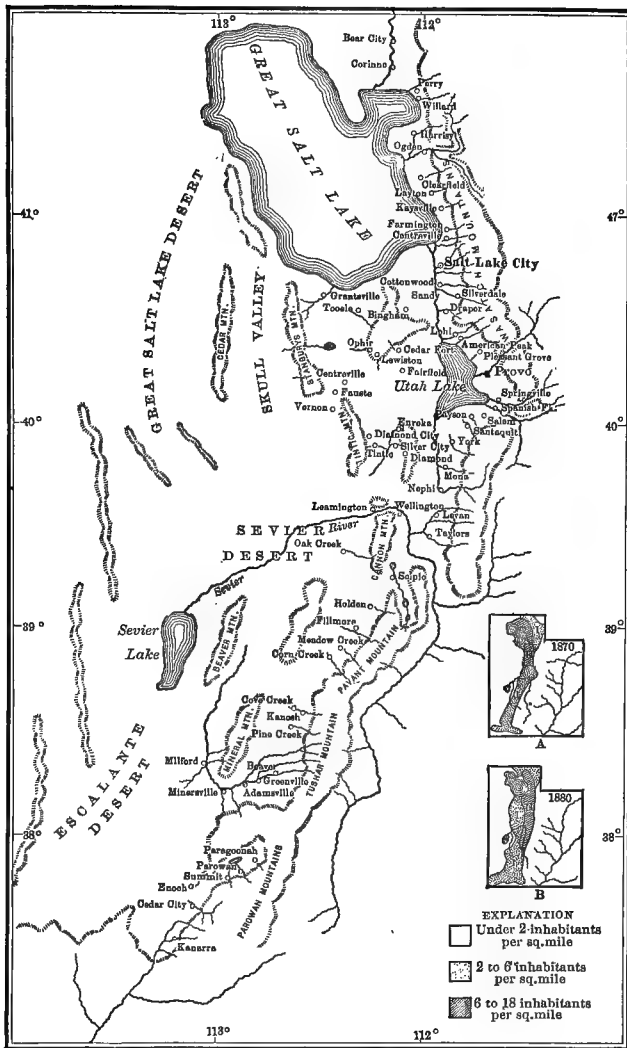


FIG. 13. Distribution of Population in Utah

the valley and its apex at the mouth of the gorge. Such an accumulation of debris is an *alluvial cone* or *fan*; or, if of gentle grade, an *alluvial slope*. Many villages in mountain valleys rest on such fans or slopes; and in desert regions fans usually determine the location of oases, — for water is found here if anywhere, — the texture of the soil is favorable for agriculture, and the gentle slopes of the fan make easy the construction of irrigation ditches. Many cities in Persia and

Turkestan are located on fans, and the distribution of the plateau population of Bolivia and Peru is, to an important degree, controlled by these forms. A striking example of this control is seen in Utah, where the population is grouped in settlements, forming a line along the west base of Wasatch Mountains (fig. 13). In this case the population would be confined to an even narrower zone if the shifting settlements of the mining camp were eliminated from the census (fig. 13, A). Alluvial fans may become alluvial slopes of many square miles in area, and a continuous supply of material may result in uniting these slopes and covering an entire lowland with the débris of mountain torrents, thus converting the isolated fans or slopes into a great piedmont *alluvial plain*.¹ The valley of California, through which flow the Sacramento and the San Joaquin, may be taken as an example. This plain, 400 miles long by 50 miles wide, has been built from the waste of bordering mountains, — the Sierra Nevada on the east and the Coast Range on the west. Great fans, 10, 20, and 40 miles in radius, have been formed by the Kern, Kings, Merced, Tuolumne, Feather, and many lesser streams. These have carried in so much material that the alluvium is in places 2000 feet in depth, with coarser deposits at the edges and finer silts of slow-moving streams toward the center. The great alluvial plain of the Po — the agricultural and industrial center of Italy — has been built forward from the Alps on the north and the Apennines on the south. The flat Ganges valley has a similar origin, and Kashmir, a waste-filled valley of 2000 square miles, is the type of many alluvial plains among mountains.

PLATEAUS

49. Introductory. The plateau is a moderately level land surface lying at a considerable elevation above the sea. No definite size or altitude is, however, to be assumed, for in a region of generally low elevation a level stretch of land of large area, less than 2000 feet above the sea, may be called a plateau; and, on the other hand, the Staked "Plains" of western Texas attain an altitude of more than 4000 feet.

Plateaus, like plains, may be the result of deposition, uplift, or denudation. Some great plateaus are formed by the accumulation of flows of lava, which continue through long periods and pile up material to a great thickness. The Deccan, of India, is a lava plateau, as are parts of Abyssinia; and the great Columbia plateau of Idaho and Oregon, 3000 to 6000 feet above the sea, is capped by sheets of lava

¹ All river-made plains are, of course, alluvial, but the term is here restricted for the sake of distinctness.

having a combined thickness of over 2000 feet. Like plains, plateaus may consist of horizontal rock, as in the case of the Colorado plateaus, the Cumberland plateau, and the great table-lands of Arabia and southern India. The New England plateau, on the other hand, is an elevated peneplain worn, by long ages of erosion, out of igneous and metamorphic rocks having the most complex structure. The plateau of central Mexico is a waste-filled valley from 5000 to 8000 feet above the sea.

50. Dissection of plateaus. Because of their elevation above the sea, plateaus are attacked by the atmosphere, by rivers, and by other agents of destruction, — a process which results in a thorough dissection of the level-topped area, producing deep valleys with intervening ridges and hills. Complicated systems of stream valleys may have removed large portions of the rock mass constituting the plateau, and the original surface be represented only by the higher peaks and ridges. Thus the Allegheny plateau of Pennsylvania, West Virginia, and Tennessee is no longer a typical level surface lying at a considerable altitude, but a surface thoroughly dissected, so that valleys and hill slopes are more abundant than flat-topped areas. Before denudation has reached this stage plateaus are cut by a series of steep-walled canyons, particularly in arid regions where atmospheric erosion is limited and the power of the stream is relatively great. The plateau region of Arizona and Utah, cut by the Colorado River and its tributaries, is practically a broken floor extending for hundreds of miles and marked here and there by deep river gorges whose presence is scarcely perceptible until one finds himself at the top of a steep wall rising from the stream beneath. In the later life of a plateau the valleys are widened and their interstream spaces cut down until isolated mesas or buttes stand on a plain as landmarks indicating the height, extent, and structure of the former highland surface.

51. Plateaus and man. The suitability of plateaus for settlement depends chiefly upon climate, but partly also on age and amount of elevation. Dissected plateaus (§ 50) are unfavorable because of the prevalence of hill slopes and the difficulties of communication. Tunnels can be built through mountains, but it is not practicable to bridge excessively wide and deep canyons, and where mineral wealth has not acted as an artificial stimulus to the growth of population, plateaus are regions occupied by peoples of limited commercial development. The Kentucky and Tennessee mountaineers and the Scotch Highlanders have developed into unique types of mankind, largely as a consequence of their difficult and peculiar surroundings.

As to their climate, plateaus are generally characterized by aridity (§ 120) and by marked daily ranges of temperature (§ 119). Owing to their climate, arctic plateaus are unfit for habitation, for example, Greenland. In the temperate zones the winds (§ 114), position of mountain chains (§ 115), and other climatic factors may produce local humid areas in the midst of general aridity. On the whole, however, the plateaus in this zone are adapted only to sparse population, one supported largely by artificial irrigation. The result of the precarious means of support may be seen in the stunted and unprogressive Indian groups on the broken plateaus of the southwestern part of the United States.

In the tropics plateaus are at a premium and furnish much more favorable conditions than coastal plains, flood plains, or wide river valleys. The climate of high plateaus in Africa and South America is extremely congenial, and where sufficient water is obtainable they support a considerable population. Cochabamba and Sucre in Bolivia, at an elevation of 8500 feet, as also the highlands of Ecuador, 8500 feet, contain the bulk of the population of those countries. In these cases the mountain ranges are so elevated that the plateau districts might well be considered as valleys among high mountains.

MOUNTAINS

52. Introductory. Mountains are unusual elevations of the land and are distinguished from hills only by their relative height and importance. Thus some of the "mountains" forming landmarks on the high plains of Texas are under 200 feet in height; Stone Mountain, in Georgia, rises only 630 feet above the surrounding country; it is, however, a prominent topographic feature. On the other hand, the Black "Hills" of South Dakota rise 2000 to 3000 feet above the plain and over 7000 feet above the sea. With the exception of volcanoes, mountains rarely occur as single masses or peaks, but are composed of a bewildering variety of scenic features, — cliffs, ridges, gorges, peaks, valleys, etc.

53. Origin of mountains. Mountains are to be considered fundamentally as parts of the earth's crust which have been uplifted to an unusual height. This uplift is the result of pressure due to minor adjustments of strain and load in the outer part of the earth, and may be exerted in such manner that strata thousands of feet in thickness are squeezed together, folded, and elevated; or that portions of the crust hundreds of miles or only a few hundred feet in width are broken

and forced high above the neighboring land. The Juras are a good illustration of mountains made by folding up portions of the earth's crust, and so recently has this taken place that their origin is revealed by their structure. The strata forming the Appalachians have likewise been forced from their original horizontal position and folded into waves of great amplitude. However, the lateral pressure which formed these ranges was applied so far back in geological time that their original structure has been destroyed, and the present ridges and valleys bear little relation to the original uplift. Mountains made by crustal fracture and the upthrusting of blocks are typically illustrated by many ranges in Nevada and southern California.

54. The effect of erosion. To whatever height mountains may be thrust by movements within the earth's crust, they are never allowed to retain their original shape and structure. The atmosphere, rivers, and glaciers are continually at work upon them, attacking their weaker portions and carving them into a great variety of topographic forms. Mountains, therefore, as we ordinarily see them, and especially those most prominent, are the result not of original earth movements but of carving by agents of denudation. The more resistant rocks stand as *cliffs*, *knobs*, *pinnacles*, or *needles*, and thick strata may produce a precipice of great height. Mountain *peaks* — such as the Matterhorn, Mt. Washington, Pikes Peak, and Mt. Everest — are the parts remaining after the surrounding material has been removed. *Ridges* are the portions left between river valleys, and all the various features of mountain scenery are forms carved by the rain and atmosphere from blocks furnished originally by uplifts of portions of the earth's surface.

55. Relation to man. So far as commerce is concerned, mountains are disadvantageous features. All the highest mountains are desert because the temperature is constantly below freezing. The texture and composition of their soil may be favorable, but the presence of slopes prevents its accumulation and hastens its removal to the lowlands. Avalanches are liable to occur on any steep mountain slope, wiping out villages and burying arable land. Both because of their physical character and their climate mountains are formidable barriers, and have had great influence in preventing or checking or directing the migration of man. The conditions of life in mountains are hard, and these localities were regarded with such terror by early man that the tangled mass of valley and ridge, the home of glacier and torrent, wild beast and evil spirit, was rarely visited by him. The Greeks found it easier to work along the seashore than back across the Balkans,

and land communication between India and China has been developed scarcely at all. So far as they are inhabited, lofty mountains, particularly outside of the tropics, are regions occupied by remnants of subdued races, not homes chosen by conquerors. The Sheepstealer Indians of Yellowstone Park, the Indians on the Sheavwits plateau, and the isolated groups on the mesas of Arizona and New Mexico are remnants of races which have lost in the struggle with the stronger, more mobile tribes of the plains. The native British survivors of foreign invasions retreated to the Welsh mountains, becoming a distinct stock and retaining the language and character of the original inhabitants. The Basques of the Pyrenees valleys and the Svanetians of the inner Caucasus have retained their identity untouched by the great political changes which have gone on in Europe.

56. Mountain passes. Low points through mountain ranges are usually at the upper ends of valleys where the rivers have cut deep into the range, either passing entirely through or meeting a stream from the opposite side. If mountains are to be crossed at all, it must be by these passes, — which, in spite of careful selection, are often at great elevation, — and the existence of a suitable pass may therefore determine the route of travel and the direction of trade for a region (§ 296). The St. Gothard, Brenner, Mt. Cenis, and St. Bernard passes have been the lines of communication between Italy and northern Europe for 2000 years. Railroad tunnels have lowered passes, yet, in spite of marvelously daring engineering feats, the pass is still a formidable obstacle to surmount. The Andes are crossed by passes at elevations of 12,000 to 14,000 feet; the historic Spanish pass at the base of Aconcagua has an elevation of 11,512 feet, and the Uspallata pass, between Chile and Argentina, of 12,600 feet. The tunnel on the Transandine line lies at an elevation of 10,400 feet, and even the St. Gothard tunnel is 3500 feet above the sea. The old route to Pittsburg from New York was up the Hudson and Mohawk rivers to Lake Ontario, and thence to Lake Erie and down the Allegheny, and it was not until 1880 that a railroad was built across the Appalachians south of the Roanoke. For many years after the settlement of California it was found more convenient to ship goods and passengers 13,600 miles by way of Cape Horn than across the Rockies and Sierra ranges by a much shorter route, partly because most of the passes through the western highlands are at a considerable elevation. Thus the Central Pacific crosses the Sierras at a height of 7000 feet, the Denver and Rio Grande reaches 10,856 feet at Marshall Pass in the Rockies, while the Denver, Northwestern, and Pacific crosses the

Front Range at the extreme elevation of 11,660 feet, — the highest point reached by a standard gauge railway in America. Khaibar Pass (elevation 3373 feet), between Peshawur and Jelalabad, is a narrow defile in the Hindu Kush Mountains, and for ages was the chief gateway between northern and southern Asia. The English hold this pass at great expense, but by so doing control the land access to India.

57. Volcanic mountains. A volcano is any opening in the earth's crust through which molten material finds an escape to the surface. Usually the erupted material, either in liquid or fragmental form, is deposited about the vent in such a manner as to produce a definite mound or cone, but in many cases no cone is built and the lava is spread out over the surface as a plateau, the original vent being entirely concealed. Such lava flows from volcanoes may extend a great distance and cover wide areas. Thus the Snake and Columbia rivers cut through great sheets of lava, some of which have been poured out within the last hundred and fifty years. One continuous lava stream in this region is 50 miles long, 1 to 3 miles wide, and 300 feet deep.

Volcanoes occur along lines of weakness in the earth's crust and may be either on land or beneath the sea. The island of Hawaii is a volcano over 30,000 feet in height, measured from the sea bottom. Many high mountains of the western United States—Rainier, Hood, Shasta, San Francisco, etc. — are volcanoes, as are also many prominent peaks of Mexico, Central America, South America, and other parts of the world. Volcanoes produce characteristic topographic forms as the result of their original activity and also as the result of the erosion peculiar to mountains of this type. During the period of activity a volcanic mountain may maintain its shape, or grow, but the forces of denudation are constantly at work, and when the volcano becomes dormant erosion begins to carve the mountain and, later, to remove it entirely from the landscape. Thus we have volcanoes in all stages of development: new cones, like Fusi-yama, Orizaba, and Colima; partly eroded masses like Shasta and Ararat; worn-down stumps like Mt. Taylor, in Mexico; and mere traces of volcanoes, determined by the character of the rock, as in Maine and in northern England.

From the standpoint of man volcanoes are destructive agents, but at the same time they furnish material for productive soil. Destruction of life may result from the expulsion of large quantities of steam, gas, and ashes, which no living form can withstand, or the streams of hot rock themselves may be the destructive agents. Herculaneum, Pompeii, and St. Pierre were completely annihilated by ashes and floods of scalding mud, and the island of Krakatoa was rent asunder

and 40,000 people killed by an eruption which produced no lava. The great volcanoes of Iceland erupt such quantities of lava as to form streams filling the river valleys. The molten rock from Skaptar Jökull (1783) covered plains and habitable valleys to such an extent that out of a total population of 50,000 over one sixth (9000) of the inhabitants perished. The emigration from Iceland in 1873 was caused by a second eruption. Not all volcanic action, however, is destructive, for the soil resulting from decomposition of volcanic material is rich in plant food and, where water is supplied, furnishes choice agricultural land. Climate, however, is the controlling factor in fixing agricultural values, and while the devastating ashes of Pelee and Vesuvius are quickly converted into agricultural lands, the ash deposits of Arizona support only a scanty flora. The soils of Java and of Idaho are weathered from similar volcanic rocks, but Java is a tropical garden and portions of Idaho a desert waste.

VALLEYS

58. Origin and history. Depressions between ridges, hills, and mountains are known as *valleys*. They may be a foot in width or may cover thousands of square miles, may be well-watered "plains" or arid lowlands, may be traversed by an ephemeral stream or by a permanent river of great volume. Valleys sometimes occupy depressions between folds or giant blocks of the earth's crust produced in mountain building (§ 53). The Jordan valley of Palestine is an illustration of water courses having this origin. Depressions of this type are, however, rare, and practically all valleys have been made by running water and usually by the particular streams now occupying them.

The process of valley formation is a slow one and many factors enter into the problem. The tendency of upland streams is to cut steep-sided ditches and to intrench themselves in the land, — to flow in gorges like those of the Niagara and the upper Yellowstone. Weathering, however, goes hand in hand with downcutting, and though in the earlier life of the river direct erosion is more rapid because confined within narrow limits, the time comes when downcutting is checked and weathering assumes a predominant rôle, causing the steep-sided gorge of the young valley to broaden and the canyon walls to melt away until finally they merge imperceptibly into the plain. The rapidity of both weathering and downcutting is affected by the character of the rocks which they meet and by the climate. In general, valleys develop more slowly in sandstone than

in limestone. The valleys of arid regions widen with extreme slowness; they remain young for a longer time and present a much more angular topography than valleys of humid regions.

After a stream has become established the shape of its valley depends upon (1) the character of the surrounding rock, and (2) the length of time that the stream has been running in that position; and all the great variety of gorge, waterfall, open stretch, flood plain, and lake seen along the river's course is to be considered as monuments left by the stream, — a record of the work it has done and of the number of years it has been in existence. The influence of composition and attitude of rock may be seen in valleys of different regions or in different parts of the same valley. Thus the Danube wanders across the Hungarian and Roumanian plains as a wide valley with scarcely perceptible borders, but at Orsova it passes through the gorge of the Iron Gate. The Connecticut, at Hartford, occupies a valley which is scarcely distinguishable from a plain, but at Middletown it enters a gorge in the rock and cuts a narrow path for itself to the sea. The stream has been in both these localities for the same length of time, but the sandstone at Hartford is much more easily eroded than the crystalline rocks of the Haddam region.

The influence of age on the shape of a river valley is readily appreciated when type localities are examined in detail. Young valleys are steep-sided gorges, deep or shallow, depending upon the height above sea. They have few tributaries; the valleys themselves are narrow, the divides between them wide. Their courses are marked by waterfalls, rapids, and lakes, and they give evidence of having done relatively little to drain the land and to reduce the irregular surface to a plain. Many of the smaller valleys of New England and Canada are young, the Colorado is young, and the great St. Lawrence system is markedly immature.

By the time they have reached maturity valleys have broadened and the divides have become sharp, so that every drop of rain finds a way already prepared to lead it to a stream and thence to the ocean, for nearly every square mile of land is reached by some tributary. Lakes are absent, waterfalls are rare, and the stream has become graded. Such valleys abound in the dissected plateau of West Virginia, where the characteristic of the country is slope, not hilltop or valley floor.

Old valleys have a low gradient, their valley bottoms are wide, their divides narrow and low. Lakes, rapids, and waterfalls are absent; the stream is sluggish, meanders across the plain, and

deposits material instead of cutting its bed. The hills of maturity have melted away to gentler slopes, and increasingly finer waste is being supplied.

59. Valleys and man. Valleys are natural lines of communication by boat, by roads along the banks, and by canals and railroads paralleling the streams. This is particularly the case in plateaus and mountains, where, in order to reach the passes, valleys must be followed up. From the standpoint of man valleys in different stages of development have various advantages and disadvantages. A plain cut by new valleys with wide interstream spaces affords the largest acreage of arable land. In old age, where valley bottoms and gentle slopes abound, the amount of agricultural land is again increased, while in early maturity, because of steep slopes and easily washed soil, agricultural conditions are most unfavorable. Cities in such locations are limited to a narrow belt of land between the stream and the base of the hills, as at Ems, Prussia, and Charleston, West Virginia. For land routes the canyon bottoms of young streams are not feasible, but in a mature state the topography forces roads to follow the valleys or the crests of ridges. For water navigation young rivers are unavailable because of their rapids and falls, and streams that have reached old age are subject to blocking by silt. Water power is at its best on young rivers, for while older and larger streams may possess greater energy, they are less easily controlled, and may be set aside for use in navigation. Floods are more abundant on mature land surfaces and more disastrous where wide-bottomed valleys have been developed by old-age streams.

An illustration of the relation between highland and valley is presented in the history of Connecticut, where the uplands were settled at an early date and are still occupied by decaying villages. The growth of population has, however, been in the valleys, where manufacturing cities have sprung up rapidly and drawn the men from the hill towns. At one time the residents of Waterbury climbed the hills to Wolcott to purchase supplies. Waterbury is now the chief brass-manufacturing city of the world, and Wolcott has scarcely enough population to support a post office. The concentration of population in valleys is shown by an examination of maps and census reports. Eighteen of the twenty-one principal cities and towns in Indiana are founded on alluvial land, and half of the population of Iowa is confined to alluvial plains. The same condition holds true in Missouri and Ohio, while two thirds of the cities and towns of Pennsylvania are located on river banks. Brigham calls attention to the fact that,

of 41 communities of the rank of city in New York, 11 are on the Hudson and 6 on the Mohawk, and that four fifths of the population and nine tenths of the wealth of that state are contained in the counties bordering the Hudson River and Erie Canal. From statistics of the eleventh census, from which these facts were taken, McGee estimated that "fully 25 per cent or 30 per cent of the population of the eastern United States is crowded upon the 14 per cent of alluvial lowland."¹

SAND DUNES

60. Wind-formed hills of any shape whatever are termed *dunes*. They rarely occur singly, but usually in groups, forming a small collection of ridges, mounds, or hummocks, or an undulating surface covering hundreds of square miles. They may lie in long parallel ridges like the waves of the sea, or be arranged in irregular order, and they vary in height from a few inches to over 400 feet. The most favorable conditions for their formation are where unobstructed winds blow over a plain covered by fine material and unprotected by plant covering; accordingly they are characteristic features of shore lines and of arid regions. Dunes travel in the direction of prevailing winds and form and re-form as time goes on, and it is to the wind that they owe their present position and their details of structure. The sweep of wind across the water is unobstructed, and in the construction of beaches a great amount of finely ground material is furnished in a form suitable for aerial transportation. The sands of the beaches are driven inland, and in their march landward they may completely obliterate previous topography, burying the original soil and destroying forests and the works of man. On the west coast of France a belt of dunes 50 to 80 feet high and 3 miles in width is advancing inland at a rate of 30 to 60 feet per year. Streams tributary to the sea are blocked and forced to run parallel with the coast line, forming large inland lakes.² For a distance of 100 miles, between the mouth of the Gironde and the Mimizan, there are only two places where the water has an outlet to the ocean. The sand dunes on this coast extend for 150 miles, from Biarritz to Point de Grave, and include 500 square miles of desert. In Holland the shifting dunes of the coast, which range from 40 to 50 feet in height, form a belt 1 to 3 miles wide, which stands as a wall to protect the Netherlands from the sea. The entire island group of Bermuda consists of shell sand, which has been molded into hills by the wind.

¹ *The Forum*, April, 1891, p. 225.

² Wheeler, *The Sea Coast*, p. 54.

The migration of dunes may result in completely destroying forests and buildings, — passing entirely over them and leaving the ruins behind. At Dune Park, Indiana, the shifting sand hills bordering Lake Michigan are now exposing dead trees which were overwhelmed, buried, and again resurrected. On the coast of Prussia a pine forest of several hundred acres was completely destroyed between 1804 and 1827, and a church on the Kurische Nehrung was completely buried in drifting sand in 1839, to be revealed again only after a lapse of thirty years. At certain points in New Jersey, within the lifetime of the present inhabitants, orchards have been buried so completely that only the tops of trees are now exposed.

It is important to man that the shifting sands, represented in dunes, should be controlled, and a large amount of money has been spent in devising means to this end. Forests and certain selected types of grass have been planted in the sand, rendering it more difficult for the wind to take hold. On the coast of the Bay of Biscay over 200,000 acres of sand dunes have been planted with pine. Near the mouth of the Vistula, Prussia has planted 14,000 acres in forests, and parts of the sand hills of Nebraska have been treated in a similar way. On low-lying coasts dunes act as a wall to ward off the attack of the sea, and in such regions effort is made to keep them in position and to increase their height and length by means of artificial works.

PHYSIOGRAPHY OF THE UNITED STATES¹

61. The United States as a whole. The United States as a whole, with the exception of Florida and southern Texas, is included between parallels 30° and 50° of north latitude, a position which accounts for its climate and weather, the character of its products, and, in a general way, for the commercial activities of its population. Topographically, it consists of a great central lowland area bordered on the east by narrow highlands and on the west by plateaus and mountains which make up one of the largest and most diversified highland regions of the world. In fact, the western uplands are so prominent and occupy such a large area that the United States might be viewed as divided into two parts by the 100th meridian, the eastern part being a lowland plain with slight elevations,—the Appalachian Mountains rising above it,—and the western part occupying nearly half of the area of

¹ This treatment of the physiographic provinces of the United States is made very general, since the purpose is to bring out clearly the broad geographic controls in American commerce.

the country, standing at an elevation of 4000 to 6000 feet, with large areas over 10,000 feet, and about 50 peaks, including volcanoes, reaching an elevation of 14,000 feet. The shore line which bounds the country has on the Pacific and the northern Atlantic border the irregularity characteristic of depressed coasts, while a typical coastal plain stretches from New Jersey to the Mexican border.

The climate of the United States is characteristic of the north temperate zone, being controlled largely by the prevailing westerlies with their cyclonic storms of great variation in speed and direction. The character of these winds, together with latitude and topography, determines the amount of heat received during the year by the different parts of the country. They are also responsible for the fact that, with the exception of California, the United States has four seasons, based on temperature. The warm states, that is, those in which the mean annual temperature is 60° or above, include South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, northern New Mexico, Arizona, and a large part of California. The temperate states (mean annual temperature between 50° and 60°) include all of the middle Atlantic section, the Ohio valley, Tennessee, Missouri, Kansas, Oklahoma, the southern parts of Illinois and Indiana, and southeast Colorado. The cold states (mean annual temperature between 40° and 50°) consist of New England, the region bordering the Great Lakes, Minnesota, South Dakota, Nebraska, Iowa, and all the states of the western-highland area. The lowest actual temperature has been recorded at Miles City, Montana, -65° (January, 1888), and the highest, 130°, at Mammoth Tank, California (August 17, 1885). North Dakota has an absolute range of 150°, Key West of 59°. With the exception of the higher mountain tops, no part of the United States is permanently too cold for vegetation; on the other hand, there is no state which has not been visited by frost.

So far as agriculture is concerned, it is important to know the time of the first and last killing frosts of the year, for this gives the length of the growing season; and since every plant species requires a certain sum total of heat in order to complete its growth, the length of the season will determine the type of product for each section. A study of the map¹ (fig. 14) will show that the length of the growing season varies considerably in different parts of the country. Thus the last frost to be expected at Phoenix, Arizona, is February 23, and the first frost of the fall is on December 3, making a growing season of almost

¹ This map, as well as other climatic data used in this chapter, is based upon *Climatology of the United States*, issued by the Weather Bureau.

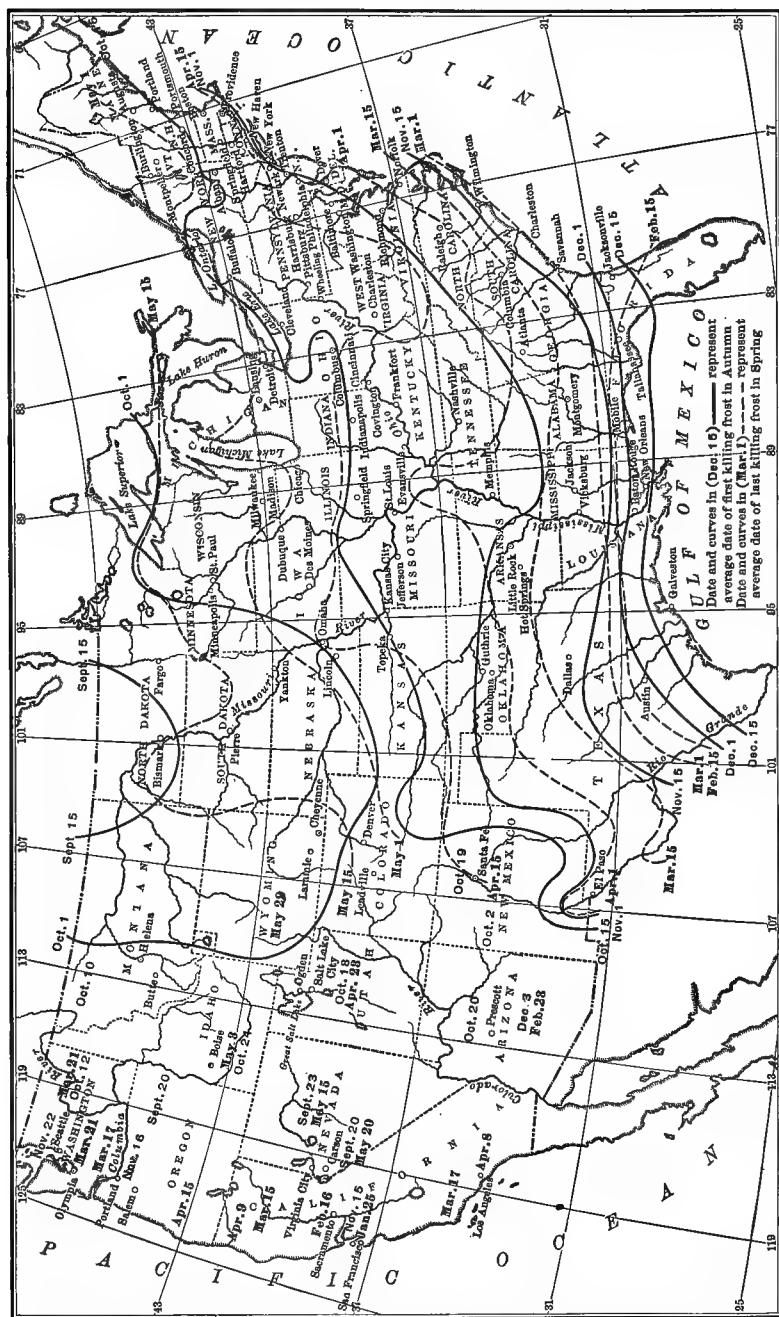


FIG. 14. Length of Growing Season in the United States

ten months ; while Augusta, Georgia, has a growing season of eight months (March 15 to November 15), central Vermont five months (May 15 to October 15), and North Dakota only four months (May 15 to September 15).

The mean annual rainfall varies from 2 inches to 105 inches, with extremes varying from 138 inches in Oregon to a mere trace of rain in the Salton desert. All of the region east of the 100th meridian has a good rainfall, and one which is favorably distributed throughout the year (§§ 121, 217). The great western-highland districts are deficient in precipitation, having less than 20 inches, an amount which decreases to 6–10 inches in Nevada, Utah, northern Arizona, and western Colorado, and reaches the extreme of 2 inches at the head of the Gulf of California.

The soils of the United States include the great alluvial plains of California and the Mississippi valley, the drained lake beds of Minnesota (§ 43), the loess deposits of the Missouri valley (§ 72), and the area of glacial soils occupying the northeastern part of the country (see fig. 15) and minor areas in the west. Elsewhere the soils are residual (§ 72), reaching the extreme of fertility in the limestone soils of central Kentucky.

The areas of the United States which are most marked in their control on settlement and development of commercial enterprises are the Atlantic coastal plain ; the Appalachian Mountains ; the central lowlands ; the western high plains ; the Rocky Mountains ; the area including the Columbia plateau, the Great Basin, and the Colorado plateaus ; and the Washington and California valleys (see fig. 15).

62. Coastal plain. The uplifted Atlantic and Gulf coastal plain (§ 46) is bordered by a fringe of sand reefs, used at the north for pleasure resorts and on the Carolina coast for the growth of the famous sea-island cotton (§ 226). The soil is arranged roughly in belts, comprising marly stretches forming rich agricultural land, and sandy stretches covered with trees used for lumber or resin. At the inner edge of the coastal plain is a narrow piedmont belt, the remains of worn-down mountains, which furnish valuable soil represented by choice agricultural lands in Pennsylvania, Virginia, and the Carolinas. Two rows of cities mark the boundaries of the coastal plain, the western row located along the fall line (§ 46), and the eastern—Norfolk, Wilmington, Charleston, and Savannah—on the seaboard. The region is well supplied with rain, reaching a maximum in late summer (fig. 16, *b, c*), during which season cyclonic storms are infrequent (§ 106).

63. Appalachian Mountains. Under this general head may be included all the eastern highlands from the St. Lawrence to Georgia. The southern New England section is a peneplain, while the eastern part of the Appalachians proper consists of parallel ridges, and the western part is made up of the great dissected Allegheny plateau, comprising western Pennsylvania, West Virginia, eastern Kentucky, and Tennessee (§ 50). This is not primarily an agricultural district, owing to the lack of level stretches easily tilled. New England, with its great water power, is the center of manufacturing (§ 269). The coal deposits of northeast Pennsylvania (anthracite) (§ 263), southwest Pennsylvania, West Virginia, Tennessee, and Alabama (bituminous) (§ 263) are the basis for the great industrial development of those states, and are responsible for the fact that Pittsburg and Birmingham are centers for the iron and steel industry. Except in the Cumberland, Shenandoah, and Tennessee valleys mining and lumbering rather than agriculture are the industries of the Appalachian belt. This region receives its maximum precipitation in winter and spring, with a considerably smaller amount in autumn (fig. 16, *d, e*).

64. Central lowlands. The central part of the United States, between the Appalachians and the 100th meridian, is commercially a unit, and its business is the raising of wheat (§ 218), corn (§ 217), and cotton (§ 225). Since it is an agricultural section, its climatic boundaries and commercial boundaries coincide. With the exception of the Ozarks, Arbuckles, etc., the entire region is sensibly flat, and even the Great Lakes are practically portions of a gently sloping plain, not bodies of water set in deep depressions. As to soil, this region includes the glacial deposits of Michigan, Ohio, Illinois, and Minnesota, the loess of Iowa and Missouri, and the alluvial plain of the Mississippi, presenting a variety of fertile land matched in but few parts of the world.

The rainfall of this district is 30–50 inches and is distributed most favorably for the needs of crops; it is marked by extreme regularity on the Gulf coast, by a spring and fall maximum along the Lakes, and a slight increase in winter throughout the Ohio valley (fig. 16, *f, g*).

Cyclonic storms are infrequent along the Gulf coast in summer, but farther to the north they are common throughout the year, for wherever storm centers originate they tend to pass out over the Great Lakes and down the St. Lawrence (§ 106).

65. High plains. Under this head is included a more or less continuous plateau extending from Canada to Mexico, bordered on the west by the Front Range of the Rockies and on the east by an

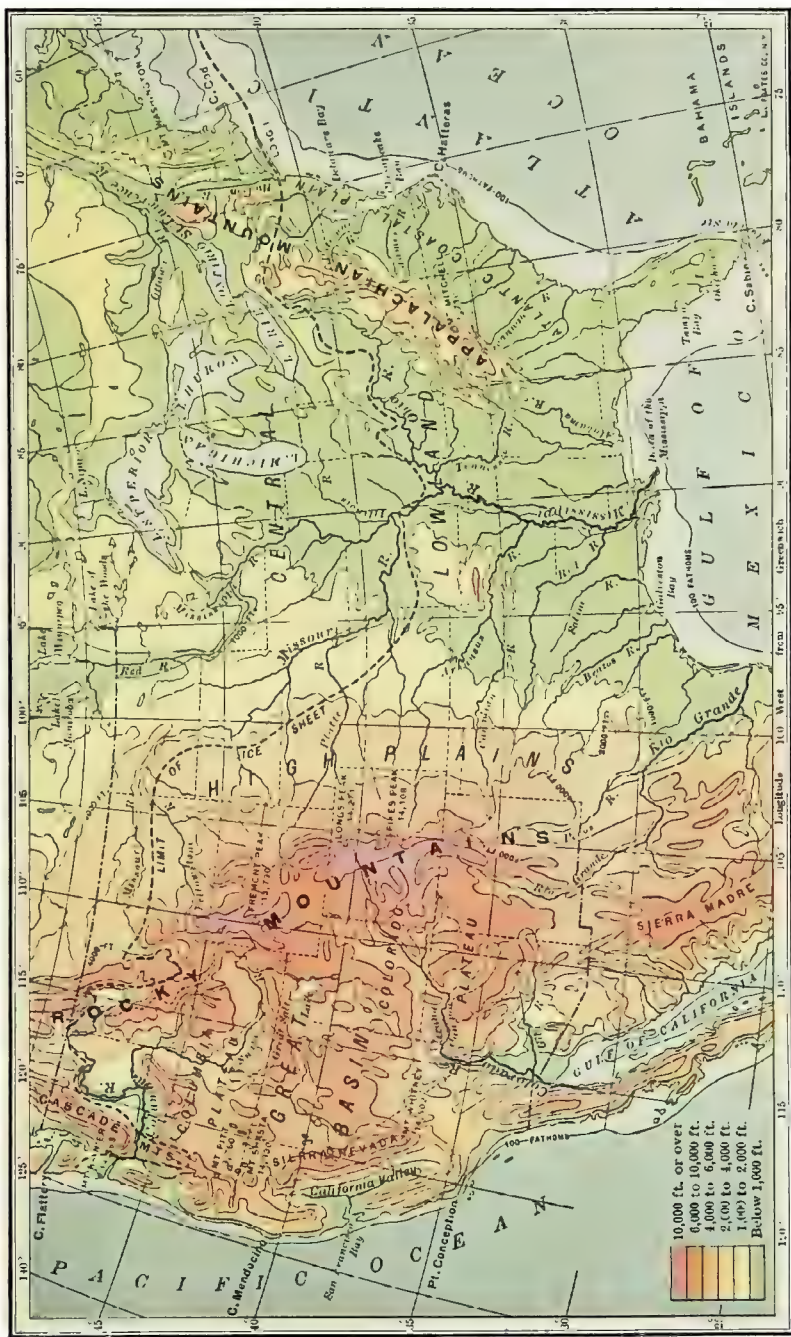


FIG. 15. Physiographic Provinces of the United States

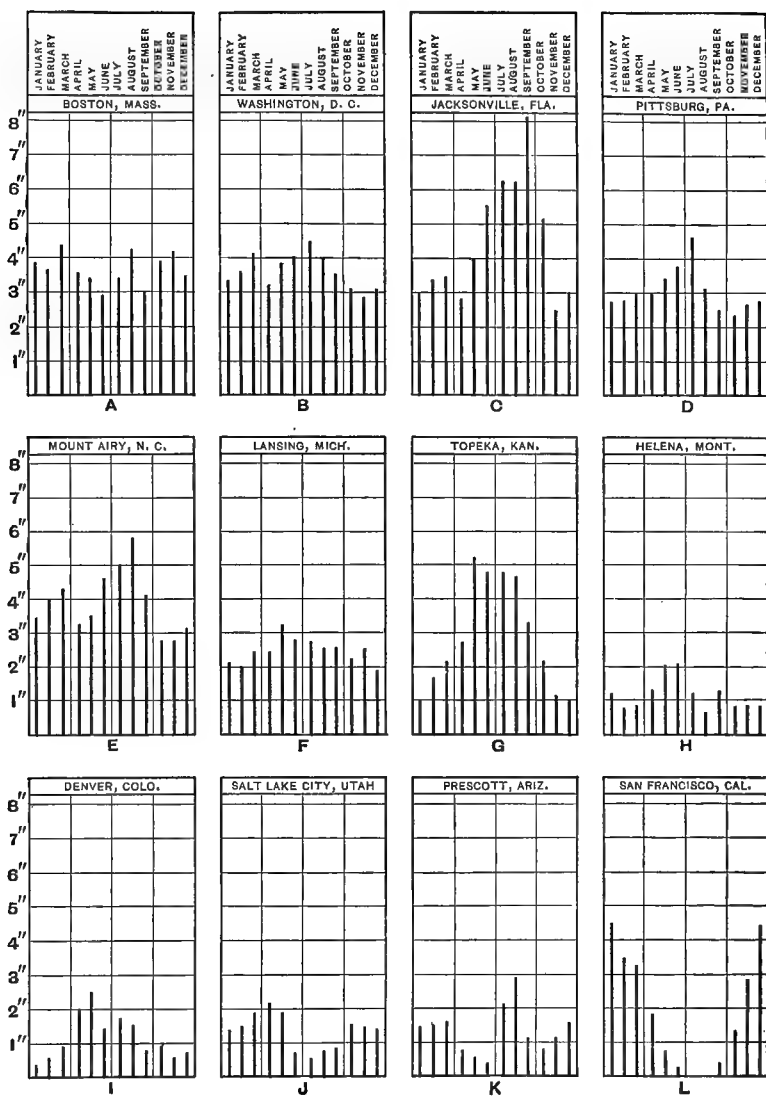


FIG. 16. Types of Rainfall in the United States

indefinite wavy line at the 2000-foot contour. At the south the Staked Plains form one of the most level areas of its size in the world. Through Kansas, Nebraska, and Dakota the plains are cut into sections by the streams draining the Rockies. Within this area are special departures from the plains type, such as the Nebraska sand hills, the Bad Lands, the Black Hills, and the volcanic knobs of Montana. Owing to deficient rainfall, agriculture has been only partially successful in this treeless district, but it includes the choicest grazing lands of the United States (fig. 16, *i*, and § 239).

66. Rocky Mountains. Near the eastern border of the great western highlands are the ranges of the Rocky Mountains, extending entirely across the country and forming the water parting between the Pacific and Atlantic oceans. Some of the valleys and "parks" of this region are centers of agricultural activity, especially of fruit growing, but level stretches of arable land are rare, the rainfall is scanty (fig. 16, *h*), and the activities of man are chiefly concerned with mineral wealth.

67. Western plateaus. Between the Rockies and the Sierra Nevada Mountains is a region of high plateaus with an area about one fifth of the entire United States. At the north is the Columbia plateau, built up of successive lava flows (§ 49). In the center, occupied by the states of Utah and Nevada, is a great basin of interior drainage, 150,000 square miles in area (§ 91); farther south are the Colorado plateaus, in southwestern Colorado, southern Utah, northern Arizona, and New Mexico, — an elevated area made up of a great series of broken blocks deeply trenched by streams. The entire region is arid, and accordingly the population, everywhere sparse (1–6 per square mile), is concentrated on oases and in narrow valleys where, with the aid of irrigation, crops may be produced (fig. 13). Mining, however, is the chief commercial pursuit. The rainfall of the Columbia plateau varies from 10 to 15 inches, the Great Basin has less than 10 inches, and the Colorado plateau has a rainfall varying from 24 inches at Flagstaff to 5 inches in southern Utah. Arizona and New Mexico are rarely visited by cyclonic storms, and what little rain falls comes largely in July and August, or is irregularly distributed (fig. 16, *j*, *k*).

68. Pacific slope. Bordering the plateau districts on the west are the high narrow ranges of the Cascades and the Sierra Nevadas. These mountains have a well-watered windward (westward) side, with a consequent growth of timber (§ 229), and an arid eastern exposure. With the exception of those engaged in mining, the population of the

Pacific slope is concerned with the cultivation of two valleys, — the northern one extending south from Seattle and Vancouver; and the southern one occupying central California. The northern valley has a precipitation of 50 to 60 inches, and rain may be expected any day from October to May. The California valley has less than half as much rain, and the lowlands in the southern part of the state are practically rainless. The precipitation is distributed so as to make two seasons (fig. 16, *l*).

Wheat, fruit, and wine are the products of this region, the former going largely to Europe by way of Cape Horn, and the fruit going eastward over the highlands to the continental interior and the Atlantic slope.

CHAPTER III

SOIL

69. Introductory. In order to occupy the earth, man must be supplied with food, and the evident source of his food is plants, or animals, which, in turn, subsist upon plants. It is therefore essential that conditions should be right for the growth of a variety of vegetable forms; or, expressed in another way, it is of great importance to man that plants have learned to support themselves and to increase in number by taking advantage of their physical environment, — earth, water, air. Some low forms of vegetation, such as lichens and “rock tripe,” are able to support life on bare rock surfaces, but most plants require loose earth in which to spread their roots. Soil, therefore, becomes a fundamental geographic control in determining the extent and character of man’s food supply. From it come the principal articles of commerce, and its tillage is the basis of civilization.¹ Man may subsist on uncultivated foods — such as nuts, fruits, and roots (cf. § 233) — or on wild animals, but an increase of population and development of civilization imply an improvement of natural species (§ 158) and an intelligent cultivation of the ground.

Soil is the covering of the earth, overlying solid rock as a sheet or mantle of waste; it is a surface layer of decomposed rock which varies in depth from a few inches to several hundred feet, depending upon the climate, the character of the rock, and the length of time the soil has been forming. The moon has no soil, for it has no atmosphere, and the solid, fresh rock from the quarry is likewise without a soil mantle. The hilltops of New England have a very thin covering of soil, because most of that which had been forming for ages was carried southward and into the sea by the continental glacier. In Georgia, on the other hand, the soil attains a depth of nearly a hundred feet; in the tropics its depth is even greater; and on some alluvial plains the decomposed rock extends for a depth of over a thousand feet. All of the earth’s surface above the sea is subject to soil formation because it is exposed to the atmosphere, whose

¹ In France 50 per cent of the population are engaged in agriculture, while statistics show 60 per cent in Spain, 90 per cent in Russia, 95 per cent in India, and 35 per cent in the United States.

chemicals are effective in rock decomposition, and also to the mechanical action of wind, water, and ice.

70. Physical processes. Rocks are shattered by sudden changes of heat and cold, by roots which force their way into crevices, and, in greater degree, by water which enters joints and cracks, visible and invisible, and which, upon freezing, breaks the rocks into innumerable fragments, continually reducing their size and, at the same time, increasing the surface exposed to chemical action. Rocks are also eroded by glaciers which, because of their great weight and their slow but irresistible motion, are competent to crush rock fragments, grind boulders to powder, transport ancient soil and new soil from place to place, and to cut grooves into the solid rock itself. The presence of glacial "rock flour" is responsible for the great fertility of the soil of southern Sweden, and a large part of the north temperate zone owes its soil to glacial agencies. Rivers likewise aid in soil-making. They wear the bottoms and sides of valleys, transport material and deposit it in the form of flood plains, fans, and deltas, making the richest, most easily tilled lands of the world. Winds also, when armed with sand grains and driven against ledges, are effective in reducing rocks to dust and may serve to transport loose material of all sorts, depositing it as dunes (§ 60) or as wide plains of fertile loess (§ 72).

71. Chemical processes. The action of chemicals in rock decomposition is much more widespread and effective than all other forces combined, for the atmosphere and ground water are everywhere at work, producing chemical changes, and no part of the earth's surface is beyond their reach. Water, when it falls as rain, and, later, when it enters the ground or runs off in streams, is charged with certain acids which are able to decompose the firmest rock. The most effective chemicals are carbon dioxide (CO_2), oxygen from the air, and various acids furnished by certain low forms of life or by decaying vegetation. Armed with these weapons, the water enters the ground through joints and crevices along channels furnished by roots, and even through rock itself; and since no part of a ledge is able to withstand these chemically charged waters, all rocks gradually decay. Working in connection with physical processes, chemical agents tend to loosen the bonds which hold rocks together, to reduce rock masses to smaller and smaller fragments, until, finally, firm rock is converted into the unconsolidated, impure material recognized as soil.

72. Classification of soils. Soils are of two main types: (1) residual, those which have originated in the place where we now find them, and (2) transported, those which have been carried to their present

resting place. *Residual soils* are the result of the decomposition of rock *in place* by the continued process of weathering, and they contain the minerals of the original rock, with the exception of those which have been removed by acid-laden waters. If the rock underneath is granite, the soil will be decomposed granite; if the bed rock is limestone, the soil will be weathered limestone. Limestone is so readily dissolved by ground water that its residual soil may consist partly or entirely of the impurities in the rock, and its fertility may be accordingly affected. The "red earth" of Bermuda and the red clays of the southern Appalachians are limestone soils of marked fertility, but in parts of Maryland it is necessary to supply lime to "limestone soils," so complete has been the removal of this easily dissolved substance.

A quarry section through residual soil, extending from the surface to the unchanged rock below, shows the following divisions: (1) *soil*, usually gray or brown, rarely black or yellow, consisting of minute fragments of rock together with broken roots, leaves, etc.; (2) *sub-soil*, much like the soil in texture, but usually different in color and containing less organic matter; (3) a considerable amount of partly decomposed rock, increasing in solidity with the depth; and, finally, (4) the firm rock itself, fresh enough to be used for building. The different parts of the section record the amount of chemical and physical decomposition. Examples of residual soils are the irrigated lava plains of Idaho and Washington, the Black Prairies of the cotton states, the laterite of India, and the famous "black earth" of Russia, which extends from the valley of the Dnieper to the base of the Urals.

Transported soils have been carried from their place of origin and deposited elsewhere, and are therefore much less uniform in texture and in composition than residual soil. They may consist of material collected from a wide area and may be totally unlike the bed rock on which they rest; furthermore, there is no gradual transition from soil to ledge, but rather an abrupt change from loose soil to firm rock. Sometimes the transition is so sudden that rock suitable for building is in immediate contact with soil fit for agriculture.

In accordance with their origin, transported soils are divided into three classes,—alluvial, glacial, and eolian. *Alluvial soils* are carried and deposited by streams, and consist, accordingly, of gravels, sands, and the finest silts. They constitute the soil of the flood plains, deltas, and alluvial plains and valleys of the world (§§ 44, 45, 48). They are the most easily cultivated of all types of soil because of the absence of stones and because of their horizontal position, and

they are ordinarily fertile, owing to the freshly ground mixture of rock and vegetable waste with which they are annually supplied.

Glacial soils exhibit a great variety of aspects and are of various degrees of fertility. The soil deposited directly by the ice, called *till*, is an unsorted mass of boulders, pebbles, sand, and clay of all sizes and kinds. The material deposited by water from the melting ice is *stratified drift*, and though it varies greatly in size of grain, composition, etc., it always shows evidence of sorting and deposition by running water. All classes of glacial soils show great variation in character within short spaces, — spots of fine-textured fertile soil alternating with areas covered with large boulders or with deposits of compact clay which serves as a matrix for numberless rock fragments. The same farm may contain till and stratified drift of several varieties, characterized by differences of texture, composition, and fertility, and the wide areas of uniform surface characteristic of regions covered by residual soil are unknown in glaciated districts. Scandinavia, England, northwestern Russia, as well as the great Baltic plain of Germany, are covered with glacial soil; New England, New York, Ohio, Michigan, Indiana, Iowa, Minnesota, and Canada constitute one great sheet of ice-borne material; and in addition to these continental areas, hundreds of mountain valleys owe their fertility to a vanished ice sheet. In parts of New England, boulders of the till are so large and so abundant that agriculture is impossible, and the stony fields of New York, Ontario, and Scotland require special treatment. But in spite of variability and numberless boulders the glacial soil of northern Ohio and Indiana is much more fertile than the residual soils of the southern parts of those states, and the drift of Illinois and Iowa includes some of the choicest farm lands of the world.¹

Soils of *eolian* origin (that is, wind-made soils) are always fine textured and owe their commercial value to their position and composition. The sand and dust carried by winds and molded into dunes is usually too loose and shifting for agricultural purposes, but sediments in regions of prevailing winds may be deposited in such manner as to make plains of easily tilled soil.² Such wind-made soil, usually called *loess*, is of great agricultural value, and makes up the rich lands of the upper Hwang-ho, much of the corn belt soil (§ 217) of Nebraska, Iowa, and Missouri, as well as some of the choice farming lands of the Danube, Rhine, and many smaller valleys.

¹ The portion of the United States covered with glacial soil is shown in fig. 15.

² The amount of dust carried by winds is very great; a storm in the Sahara (Algeria) in 1901 deposited 1,800,000 tons of dust over Europe, extending even to Russia.

Talus soil. The sides of hills and the lower faces of cliffs in temperate regions are usually covered with fragments broken from the ledge above, and where the cliff has been thoroughly exposed to the action of weathering, these blocks form a slope of loose fragments extending from the base to the summit. This material is the *talus*, the blocks of which are gradually decomposed to soil and occupied by a variety of plant forms, particularly grapes and other fruit, which find on these slopes the greatest possible exposure to the sun.

The classification given above is designed to explain those broad soil distinctions which have the most obvious control over the distribution of agricultural products within a single climatic belt. From the standpoint of the practical farmer a much more detailed classification is required, one in which not only origin but also composition, texture, sun exposure, and, especially, water content are taken into account.

73. Plant foods. Soils are composed of many different elements, but thus far plants have learned to make use of less than 20, and a still smaller number is required for ordinary plant development. Analyses show that even the richest alluvial soils may contain less than 5 per cent of food directly available for plants. The following elements are absolutely necessary to support plant life, and a soil completely lacking in any one of them is infertile: oxygen, hydrogen, nitrogen, potash, lime, magnesia, phosphorus, sulphur, and carbon. Oxygen and hydrogen are derived from water, lime and magnesia from limestone and dolomite. The value of water is obvious, and the rôle played by lime and magnesia is shown by the fact that the ash from a grain of wheat contains 12 per cent of magnesia and 3 per cent of lime. Potassium is widely distributed in the earth's crust, constituting part of some of the most common minerals, — as feldspar and mica, — but it is so readily taken into solution and carried away by ground water that it is one of the critical factors of agriculture. Phosphorus from apatite or plant and animal remains, sulphur from pyrite and gypsum, together with nitrogen, form protoplasm, without which no plant life is possible. Nitrogen is absolutely essential for plant growth; the supply of this gas in the atmosphere is unlimited, but the amount available in the soil is not, and accordingly the productivity of agricultural lands does not reach its highest point. To offset the deficiency of nitrogen, guano and other nitrate-bearing deposits are worked. The best of the manures containing available nitrogen is nitrate of soda, but at the present rate of consumption — one and one-half million tons per year (1905) — the known deposits will be

exhausted in fifty years.¹ Any method, therefore, by which nitrogen can be drawn from the inexhaustible storehouse of the air is of the greatest importance to mankind. It is for this reason that the discovery of Hellriegel, in 1888, that certain bacteria which feed on the roots of plants supply the plants and the soil in which they stand with nitrogen from the air, was one of the greatest discoveries of modern times. These nitrogen-fixing germs are especially at home on the roots of peas, beans, alfalfa, and related plants; and by the addition of such germs the nitrogen content of the soil may be brought to the proper standard, and the productivity of fields greatly increased. If the experiments now being conducted to extract nitrogen from the air by electrical processes are also successful, the yield of the world's agricultural lands may be multiplied a hundredfold. The importance of nitrogen in plant growth may be seen from the fact that a crop of oats yielding 60 bushels per acre requires 73.3 pounds of nitrogen, and that there is in the average soil only enough nitrogen for 72 crops; fields would therefore "run out" in less than one hundred years if their nitrogen content were not renewed. The carbon of the soil is obtained from the carbon dioxide of the air and occurs generally in the form of humus.

In addition to these nine elements, which are absolutely essential to plant growth, there are a number of others which play minor rôles. Iron, for instance, is necessary to develop green foliage, and salt seems essential for the transference of sap.

74. Organic material in soil. Soils are primarily decomposed rock material, but agricultural soil is disintegrated rock plus organic material, a mixture in which both ingredients are essential, for neither freshly powdered rock nor a mass of vegetation is arable soil, although plants may flourish for a brief period in either. The organic material in soils is ordinarily in the form of decomposed vegetation — humus — derived from plant roots, leaves, etc. "During its lifetime a tree contributes many times its weight to the organic parts of the soil."

Earthworms contribute soil material and, at the same time, serve to mix the rock with vegetable debris, for they have the habit of bringing earth to the surface and exchanging it for fragments of leaves and grass which they carry into their burrows. So abundant are earthworms in the temperate zones, — thousands in a single acre, — that the whole superficial bed of vegetable mold passes through their bodies every few years, and it is probable that they have a

¹ Woods, Dept. Agr. Yearbook, 1906, p. 125. *The Daily Consular and Trade Reports*, February 10, 1909, gives one hundred and thirty years as the duration of the nitrate supply.

notable part in maintaining the fertility of the garden lands of Europe and America. Generally speaking, *ants* do for sandy soils of temperate zones what earthworms do for clay and loam, and in parts of the tropics the soil looks as if it had been "literally turned inside out" by species of ants which have excavated chambers and galleries, requiring the removal of many tons of earth daily. Artificially, the organic and inorganic constituents of soil are mixed by plowing.

75. Fertilizers. The above statements regarding plant foods explain the reason for supplying fertilizers to the land. Some soils are deficient in lime, others in potash, and still others have all the necessary ingredients except nitrogen. It is the task of the agricultural chemist to determine what plant foods are absent from soils and to devise means for supplying the deficiency. Gypsum, lime, marl, and various phosphate rocks are used as fertilizers, as well as guano from the coast of Peru, Chile, Mexico, etc. Bone and ash are imported from the stock yards of South America, and farm manure, cottonseed waste, refuse from slaughterhouses, seaweed, fish, and even sweepings of streets are used for this purpose. The flood plains of the Brahmaputra, Ganges, Nile, Mississippi, and other great rivers of the world are fertilized naturally by annual additions of ground-up soil and vegetable accumulations.

76. Water in soil. As a source of plant food, soil is composed not only of inorganic fragments mixed with bits of vegetation, but contains also air and water. Water surrounds each soil grain as a film and holds mineral food in solution, so that roots may absorb it directly, and the water which plants imbibe is therefore not only a food and an agency for increasing the supply of food, but it acts also as a vehicle to carry the nutritive substances directly to the plant. Since the yield of crops is in direct proportion to the supply of ground water, and since few places have sufficient water to produce the maximum crops, land values depend largely upon the capacity of the soil to hold water or upon the amount actually supplied to it. The finer the soil the more water it will hold, and conditions are most favorable when the water table (§ 94) is a short distance below the surface, neither high enough to exclude soil air, nor low enough to be beyond the reach of roots. Under ordinary conditions an abundant rainfall insures a covering of vegetation, but unfavorable composition, for example, absence of a certain plant food, presence of poisonous substances, or unsuitable texture, may more than offset the advantages of a satisfactory water supply. It is, therefore, no uncommon experience to see arid spots in humid regions. In arid regions the tillable acreage has been

largely increased by artificial supply of water. Extensive irrigation works have long been established in India, Egypt, Spain, and elsewhere, and the United States is now engaged in elaborate enterprises of this sort. Under these artificial conditions water may be supplied when needed, that is, in the growing season (§ 121), and a relatively small amount is therefore sufficient for high-grade agriculture. By means of irrigation a region with a favorable climate, like Sicily, may have the seasons merged into one, so that fruit can be harvested in any month in the year. Even in humid regions much is to be accomplished by irrigation. Lombardy has greatly increased its yield of field crops by this method, and many valleys in the Alps and other mountainous districts are artificially supplied with water. During some experiments conducted at Ayreshire, Scotland, 80 stacks of hay were taken from a field which produced 12 before irrigation by sewage, and in Wisconsin $14\frac{1}{2}$ tons of corn were taken from an acre of irrigated land which formerly produced but 4.¹ Even among the sand dunes in Belgium irrigation has produced very satisfactory results.

77. Soil temperature. Plants have adjusted themselves to a fairly wide range of temperature, but any given species is rather closely limited to a definite climatic zone. The minimum heat required for germination varies with the plant species: 32° to 41° F. for wheat and oats, 40° F. for barley, 49° F. for corn, and 60° F. to 65° F. for melons. Germination is much more rapid, however, at temperatures ranging from 77° to 100° F.; thus the most favorable temperature for wheat is 88° , for corn and pumpkins 92° to 101° F. Corn which germinated in three days at a temperature of 65.3° F. took eleven days when the temperature dropped to 51° F. Growth in most cultivated plants starts between 45° and 48° F. and attains its optimum when the soil temperature reaches 78° to 90° F. Below 45° F. most plants not only refuse to grow but are the prey of certain mold and rot bacteria. Some soils are too cold for agriculture, but since growth is a chemical process and requires heat, soils are rarely too hot. From the figures given above it is obvious that during a cold or late spring seeds may rot in the ground or germinate so slowly that a crop does not mature. In fact, conditions may arise when a variation of 10° from the normal temperature for April or May may decrease the corn crop of a district by 50 per cent.

78. Arid and humid soils compared. Some of the earliest civilizations developed in regions where soil water was supplied by irrigation.

¹ King; *The Soil*, pp. 271, 272.

In Asia the Punjab was the seat of early Indian civilization, not the rain-soaked district of Assam. The same is true of Persia, Asia Minor, and Turkestan. Egypt, Carthage, and the oases in the Libyan and the Sahara deserts, rather than the valleys of the Congo and the Zambezi, were settled in Africa. Greece, southern Italy, and the Spanish centers of Valencia, Granada, and Malaga are seats of early European civilization, and in America, Peru and Arizona were occupied by more highly civilized tribes than the valley of the Amazon or the flood plain of the Mississippi. One reason for this seeming paradox is the fact that arid soils excel humid soils. With the exception of water, soils of desert regions are richer in plant food, since potash, phosphoric acid, and sulphur have been accumulating for ages, unaffected by the leaching action of ground water. Arid soils are prevailingly calcareous, and they also have a supply of nitrogen, for the humus which they contain, though small in amount, is rich in food value. Soils containing these ingredients, plus water, form an extract which is theoretically the best possible for the growth of plants, and thus it happens that 10 to 20 acres of irrigated land in a desert area may have a producing capacity equal to 100 to 160 acres in a humid region.

79. Adjustment of plants to soil. It must be borne clearly in mind that plants have adjusted themselves to soil, not that soils have been made to fit plants (cf. §§ 133, 136). The only types of vegetation which could have existed before soils are mosses and lichens, possessing neither roots nor trunks. As soil deepened and its water capacity increased, plants learned to look to it as a source of food, sending elongations downward to reach the supply. In this way roots seem to have been developed, and trunks and branches with them, increasing in size with the supply of food. In the struggle for existence certain species have developed much more fully than others, so that there is a great variety of vegetable forms ranging from microscopic bacteria to the giant sequoia towering to a height of 350 feet. The details of root adjustment are interesting in this connection. Since for vigorous growth it is necessary that a large absorbing surface be brought into contact with the water-covered grains in the soil, roots are developed in enormous numbers and reach far and wide in search of food, until practically every cubic inch of forest land or cultivated field contains a number of threadlike fibers. Four stalks of corn which were found to use 150 pounds of water in 13 days had roots whose combined length was 1.1 miles.¹ Roots of apple trees are known to extend 45 feet from the trunk, and even small plants like wheat

¹ King, *The Soil*, p. 210.

may reach into the ground 7 or 8 feet below the surface. Where food is unevenly distributed, as along streams or at the edge of woodlands, roots are developed accordingly, and are therefore arranged in a very unsymmetrical fashion. In New England cities, roots of large elms in some cases run but a few inches below the surface and may even be exposed on the streets, and buried water pipes show roots wrapped tightly about them, extending into the joints in search of food. In arid regions, plants necessarily develop greater extent of root surface. Buffalo-berry roots 50 feet in length have been found in Nebraska, and it is not an uncommon sight to see small shrubs or even herbs with roots extending 10 to 30 feet from the stalk.

The character of plant food varies, particularly in residual soils, with the character of the rock, and accordingly soil types are accompanied by characteristic groupings of plants. The Pocono ridges of Pennsylvania and the "barrens" of eastern Kentucky and Tennessee are marked by stunted growths of scrub pine and red and black oak, while the Silurian limestone immediately adjoining maintains walnut, blue ash, etc. Certain types of trees may be used as guides in tracing the coal-measure outcrops of Pennsylvania, and in eastern Maine the hard woods of the Aroostook limestone are separated from the soft woods of the crystalline rocks farther west. In Holland the vegetable products of the sandy soil are principally rye, buckwheat, and potatoes; while the chief products of the fluvial and marine clays are hops, rape seed, sugar beets, tobacco, and wheat.¹ Potatoes from the "red lands" of Dunbar "sell at 80s. to 90s. per ton when potatoes grown upon the Lincoln warp soils are sold at 60s. and those from the black soils of the fen countries are fetching 45s. to 50s."; this being due to the fact that "red-land" potatoes can be cooked a second time without changing color.²

With the exception of elms, most of the common trees flourish on limestone soil, and regions underlain by this rock usually furnish abundant plant foods and are agricultural garden spots, as, for instance, the "greensands" of England and the limestone soil of the "blue-grass region" of Kentucky. Indeed, lime, by promoting tilth and by its direct use as a plant food, seems to be an ingredient of prime importance to soil, and the popular proverb that "a lime country is a rich country" is in accord with the scientific facts. Speaking generally, it has been well said that "the natural vegetation of any tract represents the best adaptation of plants to soils, in the results of long periods of the struggle for existence between competing

¹ Kan, in Mills's International Geography, p. 219. ² Hall, The Soil, p. 1.

species; the survivors being those best adapted to the entire environment.”¹

80. Conservation of soil. Soil and climate are the elements which determine the variety and abundance of plant life. Modifications of climate are not in the control of man, but the conservation of soil is in his hands, and it is therefore of vital importance to guard these stores of plant food. Under conditions existing in the United States it may take 10,000 years to form one foot of soil, and the 4 feet demanded for agriculture may thus require 40,000 years. If an inch were wasted each thousand years, the soil-making agencies would supply the loss; more than that means disaster, and in many places disaster has come as a result of careless cultivation. The devastated lands of Palestine, of China, and the bare slopes of the southern Appalachians are marks made by man, — scars which may not be healed for thousands of years. A tree which has been growing for a hundred years may be cut down by a woodsman in a few minutes, and the soils which have been forming for millions of years on mountain slopes may be destroyed in a season by forest removal (§ 231). It should be borne in mind that the supply of soil is limited. Its conservation is not a mere question of relative fertility or yield of crops, but involves the preservation of the soil itself, without which life on the earth must cease.

¹ Hilgard, *Soils*, p. 487.

CHAPTER IV

WATER OF THE LANDS

81. Introductory. Probably no other physical factor has exerted such control over man's advancement, civilization, and migration as the supply and character of water. The normal human adult consumes daily between three and four quarts of water, and when we consider that this liquid is an important part of his food supply and, at the same time, the part which is most likely to contain harmful organisms, its relation to human life is readily understood. Furthermore, the plants on which man depends for food require enormous amounts of water to bring them to maturity. It takes 300 tons of water to produce a ton of corn, and in order to produce a ton of dry oats the oat plants must drink 500 tons of water. On the average it requires 325 tons of water to produce one ton of dry matter in the common field crops.

In order to be satisfactory the domestic water supply must be considered with reference to its location and the density of population. Thus the first European emigrants were satisfied with the streams of fresh water which entered the Atlantic from New England and the coastal plain. Later, cisterns were built to store rain water, as is now common in Charleston, New Orleans, Bermuda, and certain tropical regions. As the pioneers made their way westward, their movements were, in large measure, influenced by water supply. Springs determined the location of camps, and many a log cabin built by some practical frontiersman near an abundant spring of water was the nucleus about which has grown a permanent village.¹ With the change from hunting and lumbering to agriculture a new problem was presented, for much of the best tillable land was found to lie above the water courses where there were no springs. Furthermore, the cultivation of the uplands resulted in polluting the water and destroying the regularity of flow of the springs lying at a lower level. To remedy this defect, springs were at first deepened and holes dug where seepage indicated the presence of water near the surface. These were the first wells. As the demand for easily accessible water

¹ For an account of the history of potable waters in the United States, see McGee, United States Geological Survey, *14th Ann. Rept.*, Part II.

increased, wells were dug without regard to surface indications, and this artificial supply soon replaced the natural supply from streams and springs, until the farm or the village home without its well was a rarity. However, as the population increased, the soil often became charged with poisonous products which found their way into the wells; and the old oaken bucket was no longer a symbol of purity. Wind-mills, steam pumps, and iron pipes are much better indicators of an uncontaminated water supply than are open curbs and well sweeps. The safest method of securing water is to store it in reservoirs, where it may be constantly under the surveillance of trained scientists.

The water supply of the earth is included in rivers, lakes, and ground water. In the first instance the world's entire supply is the rainfall, which is controlled in its amount and periodicity by the temperature and the prevailing winds, so that the earth is divided into regions of no rainfall, arid regions, humid regions, and regions of excessive rainfall. That the source of surface and ground water alike is the rainfall is shown by the fact that variation in precipitation is reflected at once by variation in the water supply. Springs are permanent or intermittent in response to change in amount of ground water, and at times of deficient rainfall, lakes are low, streams decrease in volume, and the water in wells sinks or entirely disappears.

SURFACE WATERS

82. Rivers, — general relations. Of all the surface waters, running streams constitute the most evident and widespread natural supply. They develop on lands wherever there is sufficient rainfall, and their size, which varies from that of the giant Congo to the minute rivulets which form on hillsides after a shower, is determined by the extent of the drainage area, the amount of precipitation and evaporation, and the character of the soil. The slopes forming the drainage basin may be of great length and slight grade, such as those surrounding the Yangtse and the Mississippi; they may be short and steep, hurrying the water to the sea, like those of the rivers of southern Chile and southern Alaska; or they may be marked by abrupt descents alternating with more evenly graded portions, like the New-Kanawha, which flows from the high and steep valleys of the Appalachians into the low and flat Ohio valley. In general, most of the large drainage areas and, accordingly, the larger rivers enter the Atlantic, while the Pacific receives water collected from relatively steep and short slopes (§ 1).

Part of the surface water never reaches the ocean, but is carried inland to lower depressions, where, on account of excessive evaporation, the rainfall is not sufficient to overflow the barriers. The Caspian and its tributaries form a vast interior drainage system; similar basins occur in Mexico and South America; and over 100,000 square miles of such drainage is found in the southwestern part of the United States. The water from 31 per cent of the total land surface of Africa and 52 per cent of Australia is led out upon desert flats, whence there is no escape except by evaporation and absorption.

The size of rivers is influenced by precipitation to such an extent that many a small stream in a region of great rainfall carries more water to the sea than streams in large valleys which flow hundreds of miles through semi-arid districts; and the influence of evaporation is well shown where strong streams dwindle away as they come out from highlands upon desert plains,—a fact which may be observed at the foot of mountains in any arid land. The importance of soil absorption is well known, and many instances might be cited where streams decrease in volume as they flow through districts of porous soils. For instance, the rivers on the Great Plains, such as the Platte, the Arkansas, and the Red, exhibit dry stream beds at certain times of the year, in spite of the fact that the sands beneath are charged with water. A stream in New England, underlain by igneous and crystalline rock, may carry to the sea 40 to 50 per cent of the rainfall, while even large rivers of semi-arid regions may carry less than 5 per cent, the loss being due partly to evaporation and partly to absorption by the porous soil of their flood plains.

83. Work done by rivers. A river is a working force of enormous energy, and its power is directly related to its velocity. Slow-moving streams carry silts and the finest sands, while large streams at flood season buoy up and transport with great ease large rock fragments and even bridges, piers, and houses. The material carried is deposited along the channel as sand bars, terraces, flood plains, and deltas, the method of deposition and the character of material varying with the individual stream,—a fact which makes necessary a detailed study of each stream when problems of control and improvement are to be solved. Stream action removes the surface waste from the land and results in valley deepening and widening, the final effect of which is to reduce the hills to a uniform level. Although this operation is constantly going on, the particular working season of a river is flood time, when its volume and speed are greatly increased, and when more land destruction may be accomplished in a day than during the rest of the

year. It is for this reason that forests have an important relation to streams (§ 231). Forest areas, with their tangle of roots and their ground cover of humus and mold, tend to prevent floods by retarding the movement of water from the lands and allowing it to flow more uniformly throughout the year; while in a region from which forests have been removed floods alternate with stages of very low water. Deforestation of the Appalachians has not only rendered Pittsburg and other cities of the Ohio valley liable to a greater number of disastrous floods, but has made it possible for the smaller streams to remove the soil from the uplands and to cover the valley farms with infertile deposits from their swollen waters.

84. The river system. Streams pass through regular stages of growth from the time they first come into existence and occupy but a small portion of the land until a far-reaching system of rivers, brooks, and rills has been developed, and every square inch of surface is brought under their control. This process of development may be illustrated by a theoretical example: Assume a newly formed coastal plain,—a part of the continental shelf recently raised from the sea (§ 46). No streams have ever existed on this land, and the first rainfall has no established channels to carry it to the ocean. In places there will be undrained areas from which the water has no escape. Elsewhere rills formed by the rain tend to group themselves and flow down the slope, and a stream of considerable length going directly toward the ocean may be developed. Such streams whose position and direction and slope are determined by the original land surface are called *consequent*, that is, they are controlled by, or are consequent upon, the topography, without regard to the character of rock through which they pass. As these streams lengthen and intrench themselves in the land, they discover new sorts of material in which their courses are carved and find that some materials are much more easily eroded than others. They accordingly adjust themselves to the easiest path and develop valleys whose position and size are controlled by the character of the underlying rock and not by the original inclination of the surface. Such streams are called *subsequent*. It will readily be perceived that of two streams, which in other respects are equal, the one located on rock which is easily eroded has a much better chance to develop into a large river than the one whose valley must be cut in resistant material; and it naturally follows that if two tributaries are draining contiguous areas of land, the one most favorably placed must grow at the expense of the other. In time this inequality of position shows itself in the actual absorption of one stream by another,—a well-known

process usually described under the name of "stream capture."¹ As a result of such capture and other methods of adjustment, a complete river system is developed, until each drop of water which falls has a path marked out for it through tributaries and master streams to the ocean.

85. Meanders. Rivers on flood plains and old-age streams (§ 58) which have reduced their valleys practically to plains are no longer confined to more or less straight courses, but curve back and forth upon the surface, making a series of bends and loops which greatly increase the length of the stream (§ 44). A stream with this habit is said to *meander*. In times of flood such a stream may straighten and shorten its course by cutting a new path across the narrow neck of land which separates adjacent meanders, leaving detached lakes or bayous, often called *ox-bows* or *horseshoe lakes*. In imitation of nature, man may artificially shorten a river route by cutting ditches across the bends. Thus during the Civil War, Dutch Gap, in the James, was cut to enable the Union transports to reach Richmond by a shorter channel and also to avoid dangerous bars; and one of the plans for improving the Mississippi is to straighten the channels by cutting out the curves, which have nearly doubled the distance between Cairo and New Orleans (§ 44).

86. Intrenched meanders. When a stream has established the habit of meandering, it often maintains its pattern, even after the land has been uplifted and the river has begun to cut a deeper channel. Moccasin Bend, in the Tennessee River at Chattanooga, is an illustration of this. The river comes from the lowland of the Tennessee valley and enters the highlands of the Cumberland plateau, maintaining a meandering course, in spite of the bordering walls of rock. Many streams of mountain regions flow in such intrenched meanders, and a common method of railroad construction is to tunnel through the narrow rock ridges separating two limbs of a curve, thus shortening the track and improving its alignment.

87. Streams of dry climates. One of the most noticeable topographic differences between an arid and a humid region is the character of the river valleys. Only the stronger streams are perennial, and these usually flow in valleys larger than necessary. Some valleys contain water in parts of their courses and elsewhere reveal dry beds, and many tributaries are active only at times of rain. These dry

¹ Illustration of this process and a general discussion of river development will be found in any standard work on physiography, — as Davis, Salisbury, Tarr, or Gilbert and Brigham.

gorges and canyons — known as *arroyos* and *barrancas* in American deserts and as *wadys* in the Saharan and Asiatic deserts — are characteristic features of dry climates. After a shower, water rushes down these channels with great speed and volume, but within a few hours the valley floors are again dry. Often the flood water comes without warning, which accounts for the paradox that drowning is a common death in desert regions.

88. Rivers and man (§§ 165–167, 184). The economic value of rivers is evident. In the early development of a country they are the natural avenues of travel. They are used alike by animals, by savage tribes, by civilized races of ancient times, and, to a great extent, by modern man. Lumber, ore, and other natural products are carried on rivers which, even in the age of steam and electricity, remain important highways for the transportation of heavy goods. Every large river in the inhabited districts of the world is dotted with crafts of all sorts, and the boat on the stream, as well as the train along its banks, testifies to the control exercised by these natural highways of commerce.

The development of agriculture in arid regions depends largely upon the feasibility of storing river water and leading it out onto the valley lands by means of irrigation ditches.

Streams are reservoirs for municipal water supply, and are one of the few sources from which large amounts of water can be obtained for congested districts. Omaha, Cincinnati, St. Louis, and Pittsburg are examples of hundreds of cities which rely upon filtered river water for domestic supply.

As boundaries of political divisions, rivers are commonly used and possess evident advantages. The "medial line of the St. Lawrence" separates Canada from the United States, and "the middle line of the Rio Grande, or its deepest channel where there is more than one," is the official designation of the southern boundary of Texas. Where islands exist the boundary channel should be designated with care. Ignorance of this simple geographical principle is shown in the Webster-Ashburton Treaty of 1846, the careless wording of which was responsible for the "San Juan Question" involving the possession of a group of islands off the Washington coast.

89. Lakes, — general relations. Surface water in the form of lakes is abundantly but very unevenly distributed over the world. In size these water bodies vary from tiny ponds of an acre or less to the giant Caspian (168,765 square miles), which is larger than New York, New England, and Pennsylvania combined. Lake Superior is larger than South Carolina, Lake Victoria would nearly cover Maine, and the ten

largest lakes (Caspian, Victoria, Superior, Aral, Huron, Michigan, Tanganyika, Baikal, Tchad, and Erie) occupy an area larger than the German Empire, Austria, and Greece combined. Many lakes are but a few feet deep, and even Tchad, about 10,000 square miles in area, has a depth of only 20 feet. Lake Superior, on the other hand, is 1008 feet deep, Tanganyika 1300 feet, and Baikal attains the enormous depth of 4500 feet. The water of lakes may be fresh or may contain appreciable amounts of salt, increasing in extreme cases to 18 per cent in Great Salt Lake, 24 per cent in the Dead Sea, and 29 per cent in Lake Elton, Russia, as compared with the ocean, which contains 3.4 per cent of salts.

90. Origin of lakes. Lakes are temporary features of the landscape; they are characteristic of topographic youth, and disappear long before the hills have reached maturity or the rivers developed their greatest power. Most lakes owe their origin to newly made plains or volcanoes or glaciation. Lands recently lifted above the sea are characterized by an abundance of lakes before the drainage lines have become established. It is partly for this reason that central Florida is dotted with numberless lakes. There are 150 within seven miles of Orlando, and it has been estimated that the region from Gainesville to Lake Okeechobee contains 30,000 lakes, some of them no larger than an ordinary building lot.

Volcanic agencies, directly or indirectly, have given birth to many interesting lakes. The bowls of extinct craters are commonly occupied by clear bodies of water of great depth. Lake Laach, in the Eifel district, Germany, and the Italian Bracciano and Bolsena are European examples. Small lakes of this type exist in Nevada, and an excellent example is Crater Lake, in the Cascade Mountains of southern Oregon. This body of water is 5 to 6 miles in diameter and 6239 feet above the sea; it has no tributaries and no visible outlet. The shores are of lava and rise in precipitous cliffs 900 to 2000 feet above the water, plunging directly into the depths without leaving a platform at the water's edge on which to stand. The full depth of the crater is 4200 feet, and the water attains a maximum depth of 2000 feet, — the deepest lake in North America.

The great lake regions of the world, however, are not coastal plains or volcanic areas; they are the regions which were overrun by an ice sheet in recent geological time. In North America, for instance, lakes are most numerous in the northern part, for in this district the ice sheet left a very uneven land surface abounding in hollows and pockets and in valleys partly filled with débris.

During the Glacial Age the United States was covered by ice north of a line traversing Long Island, New Jersey, Pennsylvania, Ohio, and Indiana, and thence west and northwest (see fig. 15). Because of the complete change in water channels, due to glaciation, the scenery north of the ice limit differs markedly from that south of the line. The southern rivers have regularly developed tributaries and flow in valleys corresponding in character to their age. Northern rivers, especially the smaller ones, have gorges and waterfalls. The southern states have few lakes; the northern states abound in lakes, ponds, and marshes. The Century Atlas maps show no lakes in Delaware, Maryland, West Virginia, Kentucky, Tennessee, Alabama, and Kansas. Connecticut has 216 lakes large enough to be represented on a map of the same scale, and within a radius of 25 miles from Boston there are 180 lakes; Minnesota has 476, and Maine, New York, Michigan, and Wisconsin likewise number their lakes by hundreds, and Canada by thousands. In fact, the connection between lakes and the former presence of an ice sheet is so close that the southern extension of the ice lobes could be roughly determined by mapping the margin of the lake region.

91. Life history of a lake. The life of a lake may be a day, or a season, or centuries,—depending upon its environment; but whatever their origin and setting, lakes are relatively short-lived topographic features. The forces which tend to destroy lakes are rivers and vegetation, and, in arid regions, the atmosphere. The work of rivers in the process of lake destruction is of two kinds,—filling the lake at the upper end, and draining it at the lower. The filling is accomplished by sediment from mud-laden tributary streams, which carry quantities of waste into the water, building deltas or spreading silt unevenly over the lake bottom. The basin is occupied more and more by encroaching deltas until it is converted into a plain of soft sediment through which streams, formerly tributary to the lake, wind their way. In certain localities the disappearance of these water bodies is very rapid, as is seen by the comparison of a map of a Swiss district, made in 1667, with a modern map, which shows that 73 out of 149 lakes have disappeared and farm lands increased accordingly. It is probably safe to say that more lakes than now exist have disappeared by filling since the beginning of human history.

The extinction of a lake by drainage requires an enormous amount of work on the part of a river, work which is slow because the stream has been deprived of its effective tools,—the sand and gravel and silt left in the lake by tributary streams. In its efforts to drain

Lake Erie, Niagara River has cut a gorge 200 to 500 feet deep, $\frac{1}{4}$ of a mile wide, and 7 miles long, and is working its way upstream at a rate of over 4 feet a year. Lake Tahoe, the "gem of the Sierras," is in danger of destruction by the cutting of the Truckee Canyon.

Vegetation may be equally fatal to a lake's existence. Rushes, lilies, and similar plant life find in water a congenial home, protection from other plants and animals, as well as a supply of food; and they accordingly encroach upon the lake, narrowing it to smaller and smaller compass. Numerous lakes of Scotland, Maine, New York, and other glaciated areas exhibit several stages of lake filling. The steps in the process seem to be something as follows: upon the retreat of the glacier the hollows of its former bed are filled with water, upon the shores of which hardy sedges begin to grow; then, as the seasons grow warmer and the soil deeper, gentians, daisies, violets, and many mosses secure a foothold; then the hardy shrubs come, and aspens, and pines, until the lake is surrounded with a girdle of green forest; the soil beds and moss continue to creep out into the water, gradually contracting its area, and the lighter mud particles and remains of plants and animals drop to the bottom, causing the lake to grow shallower and narrower until the last remnant vanishes. The number of water bodies extinguished by the growth of vegetation is far greater than is generally supposed. One tenth of Ireland is peat bogs, one fifth of the agricultural land of Indiana is drained swamps, and Wright estimates that there are 77,000,000 acres of morasses and bogs in the eastern half of the United States which may be reclaimed.

At the close of the Glacial Period there were probably 4000 lakes within the state of Connecticut which owed their existence to ice invasion. Ten hundred and twenty-six remain somewhat as originally formed; 420 are much choked with vegetation and are represented on the map as swamps and bogs; and the other 2500 have been drained by the natural development of stream tributaries, or filled with debris from the sides, or completely conquered by aquatic plants. They now exist as plains of small extent and form choice garden spots.¹

By organic processes small shallow lakes are rapidly extinguished and large ones, under favorable conditions, are encroached upon. Clear waters are converted into swamps, then into bogs, then into rich garden lands. Lakes, swamps, bogs, are thus seen not to be distinct species but successive stages in a life history, and bear the same relation to each other as do acorns, oak sprouts, oak trees, and oak stumps.

¹ *Connecticut Geol. and Nat. Hist. Survey, Bull. No. 6, 1906, p. 250.*

Dismal Swamp, Virginia, shows a lake in three stages, namely, a narrowed body of water,—Lake Drummond; large swamp areas with a dense tangle of black gum and cypress; and areas completely filled, which, aided by artificial drainage, now form rich agricultural land. In the case of glacial lakes on the prairie, this process is particularly rapid, and even since the settlement of Minnesota many lakes have been transformed into rice swamps, and farmers now mow hay where the pioneers shot ducks.

In arid regions lakes have a different history, for they are here under the control of climate rather than of vegetation or topography. If the rainfall is sufficient, such lakes will freshen and may overflow, but when evaporation equals or exceeds precipitation, lakes may be lowered below the level of their outlet and each succeeding year decrease in amount of water, until concentrated alkaline and salt solutions remain. Fluctuations in climate are reflected in variations in the size of lakes, and so close is the adjustment that when the annual supply and the annual loss from evaporation are about evenly balanced, lakes of the rainy season may disappear entirely during the summer, leaving broad, smooth plains. This is the origin of *playas*, which constitute such a characteristic feature of arid regions. Lakes passing beyond the playa state may leave plains of salty mud,—*salinas*,—which are incapable of supporting life. Some salinas in Turkestan cover several thousand square miles, and the salina at the outlet of Lake Poopō begins as a marshy plain and continues as a white, salt-covered surface 4000 square miles in area. Salt lake, playa, salina, are thus seen to be stages in the history of lakes of dry climates. Great Salt Lake, Utah, 2000 square miles in area, may illustrate the features of water bodies in arid districts. This lake is but a remnant of ancient Lake Bonneville, 19,750 square miles in area,—about the size of Lake Huron. Lake Bonneville was 1050 feet deep and overflowed into the Snake River, thence through the Columbia to the Pacific Ocean. With a change of climate its waters fell below the outlet and became concentrated to a brine, the salinity of which has increased until Great Salt Lake contains about 18 per cent of salts. The shore lines of the ancient lake, now high on the mountain sides, remain to tell its history, and many playas and salinas of Utah mark depressions in the Bonneville bed.

92. Lakes and man. Lakes are in many ways of direct benefit to man. They furnish, without construction of expensive dams, an abundant water supply. The water is clear, fresh, and pure and constitutes the best known source of supply for thickly settled communities.

The larger lakes, furthermore, are used for navigation (§ 307). Lake Baikal forms a link in the Trans-Siberian Railway; Titicaca is a highway across a portion of the plateaus of Bolivia and Peru; and the traffic on the Laurentian lakes, as measured by the Sault canals, just about equals the total foreign and domestic trade of New York, and is three times the tonnage that passes through the Suez Canal.¹

Lakes also modify climate, for the same reason that ocean water does (§ 3). Furthermore, a river system abounding in lakes is not subject to disastrous floods, — a fact which is appreciated when the behavior of New England streams is compared with that of the lower tributaries of the Mississippi. In fact, the most promising means of flood prevention is the building of artificial lakes on the headwaters of streams whose volume fluctuates markedly with the seasons (§ 44). Moreover, no feature of natural scenery is more attractive than lakes, and scenery has a commercial importance greater than is ordinarily realized. The chief commercial asset of Switzerland and northern New England and northern New York is their scenery. Likewise climate is responsible for the prosperity of southern California just as truly as coal is the commercial basis of West Virginia.

At their death, lakes yield valuable mineral and agricultural treasures. The deserted floors of saline lakes are covered with salt, soda, and borax. The deposits are extensive and cheaply gathered and of great commercial importance. In fact, the salt deposits of the world owe their existence to lakes of recent or remote geological times. To be sure, these water bodies occupy areas which might otherwise be converted into arable land, and, from this point of view, lakes as well as swamps are obstacles rather than aids to agriculture; yet it should be borne in mind that extinct lakes of humid regions furnish the peat which becomes the coal of later ages, and that they yield our choicest farm lands. As has been said, many of the garden spots of New York, Ohio, Michigan, and other northern states, as well as of Europe and the other continents, are a direct inheritance from vanished lakes. The land is usually level, the soil fine textured and well fertilized; it is easily tilled and yields large returns. The glacial lake which once covered parts of Minnesota, North Dakota, and Manitoba, to a depth of over 600 feet at Winnipeg, was larger than the combined areas of Illinois and Kentucky (§ 43). The bed of this

¹ In 1904 there were carried eastward through the Sault Canal 130,000,000 bushels of grain, 21,000,000 tons of iron ore, 1,770,000,000 feet of lumber, 1,000,000 tons of flour; and westward, 14,000,000 tons of coal. — Department of Commerce and Labor, Commerce and Navigation of the United States, 1904, Vol. I.

lake is the great wheat region of the prairie plains (§ 218), where the soil is rich and unencumbered by boulders and tree stumps, and the land is so level and the valleys so narrow and so widely separated that it is possible to plow a furrow or cut a swath for miles in one direction.

93. Waterfalls. It is evident that one of the most important commercial features of drainage is waterfalls and rapids, by means of which the power of rivers is made directly available for man. Waterfalls occur in streams where the evenly graded channel is interrupted by a sharp change in slope, and, accordingly, falls are of all sizes and heights, from swift-moving water in regular streams — *rapids* — to the 1500-foot column of a Yosemite. Most rivers, especially those in a youthful stage, have small waterfalls, because the beds of most streams are formed partly of hard and partly of soft materials, allowing erosion to produce an uneven surface. Thus the falls which make Columbia, South Carolina, a manufacturing city occur at the junction of crystalline rocks with the unconsolidated sediments of the coastal plain (§ 46).

Most of the waterfalls of the world, however, owe their existence to glaciation. As a result of the ice advance, rivers were forced from their channels, dams were built across them at various points, and the whole surface of the country was remodeled. When the ice retreated, some rivers reoccupied their channels; others, being unable to find their old courses, made new ones in order to avoid obstructions and find their way to the sea. The water from rainfall and the floods from melted ice supplied the rivers, which flowed over the uneven surface and fell here and there over cliffs and ridges and the banks of preglacial streams. The Connecticut River, for instance, was obstructed, and the water at Turners Falls and elsewhere was thus forced to regain its ancient route by a roundabout way. Lowell and Lawrence owe their existence to the obstruction of the Merrimac. Holyoke derives its admirable water power from a waterfall in the Connecticut. Rochester, New York, Spokane, and hundreds of other cities and villages throughout the northern part of the United States have been so located as to take advantage of waterfalls. The Falls of St. Anthony are largely responsible for the supremacy of Minneapolis (§ 272), and the powerful Niagara, representing 4,000,000 horse power, is an illustration on a large scale of the industrial importance of falls which owe their existence to glaciation. The undeveloped water power of the world is a commercial asset of great value, fully justifying the attention paid to it by various manufacturing interests.

GROUND WATER

94. General relations. Water which falls upon the earth as rain is disposed of in three ways, — a part of it is evaporated, a part remains as surface water in lakes and rivers, and a third part enters the ground to remain for a longer or shorter period of time. The amount of water in the ground depends, therefore, directly upon the amount of rainfall, and less directly upon the character of the topography and the texture of the soil. The more gently rain falls, the more of it enters the ground, and sometimes all of it is absorbed. If the surface of the country is flat, the ground will absorb more rain than if it is hilly, and if the soil is loose and open, it will take up more water than if it is compact. Taking the world as a whole, 22 per cent of the precipitation enters the rivers, and the remaining 78 per cent is divided between that which is evaporated and that which enters the ground. Certain rivers in New South Wales take only $2\frac{1}{2}$ per cent of the precipitation, while some of the New England streams carry over 50 per cent. Ground water does not occupy reservoirs, but occurs in minute quantities between the grains of rock and in joints, crevices, and planes of stratification. Chalk may hold two gallons of water for every cubic foot; sandstones may hold 20 to 30 per cent of their weight; and even dense granite contains an appreciable amount. The aggregate supply is therefore very large. In the sandstone underlying parts of Minnesota and Wisconsin there is water enough to make a lake covering these states to a depth of 50 to 100 feet. In the joints of the crystalline rocks of Connecticut there is 1 cubic inch of water for 125 cubic feet of rock. If all the ground water were squeezed from the rocks, there would be enough to cover the entire earth with an ocean of fresh water over 100 feet in depth. This great amount of water is near the surface, its amount and accessibility varying with all the factors which determine climate.

The level below which soil, subsoil, and rock are always saturated is the *water table* — not a horizontal surface, but a plane which adjusts itself to the topography. It is at less depth in valleys than on hill-sides, and it bends upwards and downwards with hills and valleys, and advances toward or recedes from the surface in harmony with variations in precipitation. Streams whose beds reach below the water table are perennial, and wells must be sunk below it to yield water. In humid regions the water table is from 10 to 40 feet below the surface, but in arid regions it may be only after years of irrigation that the table comes within reach of field crops.

Water contained in the ground does not remain stationary, but has a drift or underground flow, usually in a definite direction. This flow is rarely in the form of distinct streams ; and only in limestone regions where underground drainage has been established do such phenomena occur, as in parts of Kentucky, where the underground flow is so large that surface channels are dry over many square miles. Generally the water finds its way between the grains composing the rock or along partly closed joints, and its movement is excessively slow. With a slope of 10 feet to a mile, ground water will move in fine sand about 52 feet per year, in gravel a mile a year. Petrification, mineral springs, and land slides are also phases of ground-water work, and the ore deposits of the world owe their existence chiefly to the same cause.

95. Recovery of ground water. Underground water is returned to the surface naturally by springs and artificially by wells of various sorts. Springs may be outlets for subterranean streams, as Silver Springs, Florida, and Cascade Springs, South Dakota ; or they may be located along some crack in the earth's crust and thus be outlets for deeply buried waters, like the hot springs of Virginia, Arkansas, and Nevada ; or, finally, they may occur at the contact between strata of open-textured and water-tight rocks. In springs of this type, including probably 90 per cent of their total number, the surface water penetrates the upper beds down to some impervious layer, then follows this layer out to the surface.

Wells are holes which reach into the ground below the water table and, accordingly, vary in depth with the character of the soil, the rainfall, and other factors. Most wells are shallow, for the water table in humid regions is near the surface, and porous spaces and open joints decrease in number with the depth.

Ordinary wells receive their water supply from the ground immediately adjoining, but in *artesian wells* the conditions are different. For these it is necessary to have a water-bearing layer, preferably sand or sandstone, over which lie strata practically impervious, such as shale or dense rocks of other types. Water must have access to the pervious layer, but not necessarily near the location of the well. If the water-bearing stratum is exposed at a point higher than the well, the water will be under pressure and will rise through the upper confining layer. Thus in South Dakota a saturated sandstone bed exposed in the Black Hills is covered by clays and shales as it extends eastward. When the clay is pierced at elevations lower than the Hills, the water rises freely and supplies wells even at a distance of 350 miles from its source. The coastal plain of Texas is another excellent artesian area,

as is also the New Jersey plain. In the latter case a water-bearing bed is so completely inclosed that wells sunk on barrier beaches, as at Atlantic City, pass through salt water and reach fresh water which has traveled through rock from the western border of the state. Artesian wells do not manufacture water, and since the supply in the ground may be exhausted, care should be taken to husband the supply, particularly in arid regions.

96. Ground water and health. Ground waters carry pollution in the same manner as surface streams, and there is no basis, in fact, for the notion that "running water purifies itself within a mile," or that "water from deep sources is pure." The typhoid epidemic at Lausanne, Switzerland, in 1872, was caused by germs which passed through more than a mile of glacial débris, and at Montclair, New Jersey, disease germs carried by ground water were pumped from a well 400 feet in depth. Location with reference to surface conditions and direction of underground flow are more important than depth. Owing to sewage contamination, a commission appointed by the New Haven Chamber of Commerce recommended that "all wells in the city be abandoned for domestic supply." Typhoid epidemics are usually caused by polluted waters, and it is recognized that "the prevalence of typhoid in cities is a true index of the quality of the water supply."

97. Location of settlements. The ground-water supply has had much to do with the growth of cities and the location of farms and ranches, as well as of oases. Some districts to the east of Paris, in the Marne valley, for example, those near Verdelot, show villages and farmhouses widely scattered because the ground water is kept near the surface by the presence of an impermeable layer. Farther south, in the Seine valley, at Origny-le-Sec, the water sinks through permeable rock, requiring deep wells, and the villages are accordingly grouped where such wells have been dug. The rocks underlying the suburban districts north of London do not retain the rainfall, and the growth of the city in that direction was retarded until water was conveyed artificially. On the western plains and in the deserts of New Mexico, Arizona, and southern California many villages and farms owe their existence to the presence of a spring or well, and one of the striking features of an arid region is the presence of artificial oases, — spots of green surrounding an artesian well in the midst of a monotonous stretch of desert land.

CHAPTER V

ATMOSPHERE AND CLIMATE

ATMOSPHERE

98. General and physical. The atmosphere is the entire gaseous envelope which surrounds the earth. It retains and modifies the heat of the sun, distributes moisture, and makes it possible for the forms of life with which we are acquainted to exist on the planet. Without an atmosphere the earth would resemble the moon,—a cold, barren lifeless sphere.

The air extends to a height of several hundred miles, but one half of it is within $3\frac{1}{2}$ miles of the earth, and 99 per cent within 25 miles. The inhabitants of Tibet, on a plateau 15,000 feet in elevation, have scarcely more than half the amount of air used by dwellers at the seashore; and climbers in high mountains above 20,000 feet find it almost impossible to live on the small amount of air present.¹ Although invisible, air has a certain definite weight, varying with the altitude. At sea level the weight of the atmosphere (i.e. its pressure) is 14.7 pounds for every square foot of surface, and, accordingly, the pressure on a man's body amounts to several tons. The density of air is proportional to the pressure to which it is subjected; it is also elastic and readjusts itself with great readiness. These properties make air valuable as motive power for machinery, and account, among other things, for its extensive use in air brakes.

The temperature of the air is controlled by the sun, and air of different degrees of warmth is distributed over the earth in accordance with the effectiveness of the sun's rays. The atmosphere is, however, only slightly warmed by the direct heat of the sun, a much greater effect being produced by the rays which are absorbed and radiated by the earth. The air thus receives the sun's heat both as it comes to the earth and as it leaves the earth, and temporarily retains about 70 per cent of the whole amount derived from the sun. The upper air is everywhere cold, and in the space beyond the atmosphere the temperature remains constantly below zero.

¹ St. Elias, 18,024 feet, and Illimani, 22,500 feet, have been ascended, and in 1908 the Duke of the Abruzzi climbed 24,600 feet in the Himalayas.

The atmosphere consists almost entirely of five gases, in the following proportions: nitrogen, 76.95; oxygen, 20.61; water vapor (average), 1.40; argon, 1; and carbon dioxide (average), 0.03. Of these *nitrogen* is the element which is responsible for most of the pressure and density of the air; yet, although it is present in such large quantities, living forms have learned to make little use of it. It does, however, make possible the flight of birds, and in a roundabout way furnishes food to plants (§ 73). The *oxygen* of the air supports life in plants and animals, and is, perhaps, the most effective agent in the formation of soil. For some reason, animals have learned to use diluted oxygen rather than the more abundant nitrogen, and so dependent are they upon it, that without an adequate supply death ensues. *Carbon dioxide*, although present in small amounts, plays a most important part in nature (§ 71).

A dry atmosphere consists almost entirely of the two gases, nitrogen and oxygen, but *water vapor* is nearly always present in amounts which depend upon temperature. For instance, at a temperature of 20° F. a cubic foot of air will hold 1.235 grains of water vapor, at 40° F. it will hold 2.849 grains, and at 100° F. it will hold 19.766 grains. *Humidity* is the general term used to express the percentage of water vapor in air; the amount actually present is the *absolute humidity*, and the proportion that this amount bears to the quantity air can hold at a given temperature is the *relative humidity*. Relative humidity is the important factor, so far as man is concerned, for it determines whether the air is dry or damp, "close," or "muggy." A *dry* climate is one in which the atmosphere is far from saturation, i.e. could hold much more water vapor; but in a *damp* climate there is always an approach to saturation, although the actual amount of water vapor present may be small. Damp air in the arctics, for instance, may contain but one tenth of the water vapor held by damp air in the tropics.

The water vapor of the atmosphere may be condensed by cooling and take the forms recognized as fog, clouds, rain, snow, hail, dew, or frost. Condensation near the surface produces *fog*, at higher altitudes *clouds*, and both of these forms may disappear when the air grows warmer, thus gaining an increased capacity for holding moisture. When the condensation of water vapor produces particles too large to be supported in the air, these fall as *rain* or *snow*, the form depending upon whether the condensation takes place above or below the freezing point. *Sleet* is partly frozen snow, and *hail* is made up of raindrops which have been carried so far upward that they are frozen before they fall to the earth. *Dew* and *frost* form on the

surface and do not fall from the sky. They are the result of deposition on cool surfaces, such as stone, which cause the water vapor to condense; and they have the same relations to each other as do rain and snow.

99. Movements of the atmosphere. The movements of the atmosphere are grouped under the general term *wind*, and owe their existence primarily to changes of temperature in the air. The immediate cause is, however, the uneven distribution of air pressure. If the temperature were uniform, the atmosphere would be stationary, and the air pressure at any point would be determined by the altitude of the place. Under such conditions no winds would exist. There are, however, continual changes of temperature which affect the pressure of the air and produce movements varying from slight unnoticed flows to winds with a velocity of 200 miles per hour. That winds are related to temperature is readily observed. Air moves toward a fire-place, winds set in toward a burning building or city, and, on a large scale, the air moves from place to place on the earth's surface, following inequalities in temperature due to latitude or to topography.

The direction and force of winds are determined by differences in atmospheric pressure. More or less permanent low barometric areas are located in the North Atlantic and North Pacific oceans, and correspondingly high ones are found off the west coasts of South America and Africa; but areas of temporary high and low pressure form and disappear with great frequency in all parts of the world. The cause of the formation and dispersal of high and low areas is not fully understood, but the relation of these areas to winds is evident; for winds blow from regions of high pressure to regions of low pressure, and the velocity with which they blow is determined by the difference in pressure of the two areas and their distance apart. The controlling force is gravity: air is stationary when the pressure is everywhere the same, flows slowly (i.e. blows gently) where the pressure differences are slight, and travels (blows) with the force of a hurricane where there is a steep barometric gradient.

100. Effect of the rotation of the earth. As already explained, the direction and velocity of winds are controlled primarily by differences in temperature and atmospheric pressure, but they are modified by the rotation of the earth. The earth at the equator turns eastward at the rate of 1000 miles an hour; in the latitude of 45° — St. Paul and Portland — this speed is reduced to 750 miles an hour, and at the poles it is zero. The result of this motion is that moving bodies on the earth's surface — as winds, rivers, and ocean currents — tend to

swing to the right or left. This law has been stated by its discoverer (Ferrel) as follows: "If a body moves in any direction on the earth's surface, there is a deflecting force arising from the earth's rotation which deflects it to the right in the northern hemisphere, but to the left in the southern hemisphere." Permanent north and south winds, therefore, are practically unknown, and are replaced in the northern hemisphere by northeast and southwest winds and in the southern hemisphere by southeast and northwest winds.

101. Wind belts. The combined effect of temperature, pressure, and earth rotation is to produce air currents which are characteristic of different sections of the world, and winds are arranged roughly in groups whose boundaries correspond approximately to latitude; the borders, however, are indistinct and change their position with the seasons.

102. Planetary winds. Certain of these groups or wind belts owe their position to the fact that the earth possesses an atmosphere and rotates towards the east. They are but slightly affected by topography, the presence of the ocean, and minor variations in temperature. Because these winds are part of the earth's equipment as a planet and would exist under similar conditions on Jupiter or Mars, they have been called *planetary winds*. They include the trades and the prevailing westerlies. *Trade winds*, so called because they follow a "trade" (or straight) course, blow from about latitude 28° north and south of the equator at a velocity of 10 to 30 miles an hour. In the northern hemisphere they are northeast winds; in the southern, southeast. The westerlies are southwest winds in the northern hemisphere and northwest winds in the southern hemisphere. They are best developed between latitude 40° and 50° S., where they blow regularly throughout the year with greater force than the trades, and are known to sailors as the Roaring Forties. In the northern hemisphere they are much less constant and take part in the irregular whirls which make the north temperate continental areas so stormy (§ 128). Between the trades and the prevailing westerlies there is a belt of calms known as the *horse latitudes*, which is characterized by clear, fair weather. Along the equator, between the trades, is another belt of calms, the *doldrums*, where the weather is prevailingly cloudy and rainy. In general, calm belts are regions where the air is ascending or descending, rather than moving between equator and poles.

103. Shifting of the wind belts. These belts of wind and calm do not retain the same position with reference to latitude throughout the year, although they retain the same relations to each other. The

location of the doldrums does not coincide exactly with the equator, but with that portion of the equatorial belt where the heat is the most intense. This *heat equator* corresponds roughly to the terrestrial equator, but moves backward and forward across it as the seasons change. Moreover, it will be observed that the heat equator is not a straight line, but is much modified by topography and by the position of the ocean. Thus it comes about that during the course of a year a given locality may be visited by different belts of wind. For instance, the horse latitudes of the northern hemisphere move toward the equator in winter and away from it in summer, and any place which normally rests under this belt will have storms from the westerlies in winter and the arid climate of the trades in summer.

One result of this movement of the heat equator and the corresponding shifting of wind belts is the development of *monsoons*, which determines the seasons for southern Asia. In the northern summer, when the entire wind belt is shifted toward the north pole, the southern trades are carried north of the terrestrial equator and converted into southwest winds. On the other hand, when the wind belts shift southward the northeast trades are extended across the equator as northwest winds. In the open sea these modifications have little effect, but where the equator crosses the ocean near land masses a second factor is introduced, for the great difference in the temperature of land and sea alternately strengthens and weakens the normal atmospheric circulation. That is, the winds become powerful land and sea breezes (§ 104). The combination of these two factors, namely, the extension of the trades and the influence of land, account for the winds of India which blow with great force alternately seaward and landward, causing seasons of drought and seasons of excessive rainfall.

104. Land and sea breezes. The difference in temperature between land and water produces local winds along sea and lake shores. In the daytime the air on the land is lighter and warmer than that on the sea, and at night it is colder and heavier; winds, therefore, blow offshore in the morning and inland in the evening. Among island tribes these winds are known and followed, and the Peruvian fisherman of to-day uses land breezes to carry him out to the fishing grounds, returning at evening with the sea breezes. Coast dwellers, particularly in the tropics, look to the sea breeze as a health-giving tonic.

105. Storms. The greater movements of the atmosphere described above are fundamental factors and control the settlement and agricultural possibilities of a region, but minor and more rapid movements known as storms exercise a more direct and visible control over the

details of commerce, of farming, and of business life. Storms, therefore, become an important consideration, especially in the temperate zones, where the industrially active populations of the world are concentrated. These regions are traversed by the prevailing westerly winds, southwest in the north temperate and northwest in the south temperate zone, winds whose course is not uniformly straight but is interrupted by temporary and local disturbances, due to the formation of whirls and eddies which are known to meteorologists as cyclones and anticyclones. A *cyclone*¹ is an area of low pressure 500 to 1000 miles in diameter, *toward* which wind blows spirally from all directions. For instance, in passing across the United States (§ 61) the winds in front of an eastward-moving cyclone blow from the southeast and south and, in less degree, from the east; while the prevailing winds in the rear of a cyclone are northwest and north and occasionally west. Southerly winds contributing to the cyclonic area blow from the Gulf of Mexico or the Atlantic, and as they go into colder latitudes their water vapor is condensed and falls as rain or snow. The north and northwest winds, coming from the cooler and drier continental interior toward warmer lands, retain their moisture. Accordingly, the approach of a cyclone is heralded by stormy and rainy weather, relatively high temperature, and shifting winds, which give way to clear skies after the cyclone has passed. *Anticyclones*, on the other hand, are high-pressure areas, *from* which wind is blowing spirally in all directions: On the east side of such an area in the north temperate zone the winds are from the north and northwest, bringing clear skies and lower temperature. On the west of an anticyclone the winds are from the east and south, and the temperature accordingly rises. These cyclonic and anticyclonic areas are so large that although they move at great speed (§ 106), the different phases of weather which they represent continue from one to three days.

106. Movement of cyclonic storms. Cyclonic and anticyclonic whirls travel with the prevailing westerlies, as eddies travel in a stream, at the average rate of about 30 miles an hour; and weather changes for a given place are to be expected, therefore, at frequent intervals,² sometimes with sudden and great variation in temperature and humidity. Furthermore, these areas of high and low pressure may be large or small, well developed or imperfectly formed; they may be

¹ In parts of the United States this term is improperly used as a synonym for tornado.

² The area from Lake Superior to the Gulf of St. Lawrence is visited annually by an average of 48 storms, and in general the stormiest parts of the world lie between 40° and 50° N. Lat.

areas of very high or very low barometer ; they may move slowly or with great speed ; and their control of the weather is accordingly variable. "Cold wave," "warm wave," "high winds," "blizzards," "rainstorms," "clear, bracing air," are common expressions indicating the location and character of cyclonic areas. The paths which these storms take across the United States are shown on weather maps, where it is seen that although they vary in position, their general trend is northeast, — the direction of the prevailing westerlies,¹ — and upon this fact are based weather predictions, so valuable in all commercial pursuits.

107. Hurricanes and typhoons. Cyclonic storms originating in the belt of calms (doldrums), and associated with the heat equator during its northerly migration, are called *hurricanes* in the West Atlantic, and *typhoons* in the West Pacific and Indian oceans. They are smaller than cyclones of middle latitudes, but much more severe, attaining a speed of from 60 to 70 miles an hour. They may continue for weeks and are the most destructive storms known. Few ships are able to outride them, and the coast lines and islands of the East and West Indies have been repeatedly devastated by their force, — some of the smaller ones being swept entirely clean of trees and buildings.²

108. Local storms. Thunderstorms and tornadoes are sudden and violent disturbances of local effect and short duration. They follow the westerlies of temperate zones and the trades in the tropics, and usually occur on the outer margins of cyclones. High temperature and great humidity are necessary conditions, and after periods of intense heat, usually on summer afternoons, excessively rapid condensation of water vapor, accompanied by electric discharges, may occur, producing *thunderstorms*.³ In a clear sky dark cumulus clouds suddenly appear, the wind freshens, and rain falls ; the clouds then move eastward, and the sun shines again — all within an hour or so.

Under similar conditions, *tornadoes* may occur, in which case, clouds are seen to rush together and to reach down from the sky in the form

¹ An examination of weather maps for a few days in succession will demonstrate the path and speed of the low and high areas in the United States, as well as their relation to temperature, barometric pressure, and wind direction. Winter cyclones pass frequently over the Adriatic and Black seas, producing severe storms and high winds at Trieste and Odessa. Anticyclones over the Alps give the clear, windless weather of Switzerland. Corresponding conditions exist in the southern hemisphere.

² For a vivid picture of these storms, read Joseph Conrad's *The Typhoon*.

³ These storms are most frequent in the tropics. Bismarckburg, Togoland, has an annual average of 200 ; Java, 167 ; Leon, 141 ; Mexico, 138 ; New Guinea, 97 ; Vivi, on the Congo, 95. The annual average for the United States varies from 2 on the Pacific coast and 12 in New England to 50 in Mississippi and 55 in central Florida.

of a long, swinging, funnel-shaped mass, nearly or actually touching the earth. This pendent cloud mass, whirling at the rate of 100 to 200 miles an hour, passes across the country with the speed of an express train, sweeping a path of from a few feet to a half mile wide, within which narrow limits its force and destructive power are beyond comprehension; trees are uprooted, buildings demolished, feathers plucked from birds, and, in some of its wilder manifestations, water is sucked from ponds, straws are driven into boards, men are hurled through the air, and bridges and even locomotives are handled with ease. On the North American continent these severe storms are most likely to develop in the area of which Kansas, Missouri, and Iowa form the center. Ten per cent of the tornadoes recorded between 1794 and 1881 occurred in Kansas; and in the above-mentioned states, with the addition of Illinois and Georgia, occur practically all of the 150 tornadoes recorded annually in the United States.

CLIMATE

109. Introductory. The importance of climate as a geographic control is evident. Plants and animals and even men may be roughly subdivided into classes in accordance with the climate of the place they occupy. The trees of the tropics are unlike those of the arctics or even of the temperate zones. The topography of such regions is different, the soil and water supply are different, buildings and other works of man are different, and man himself shows differing characteristics, some of which are ascribed to his climatic environment (§§ 147-148, 172, 174-175, 197-198). Climate is a barrier to the migration of plants and animals, including man; it controls man's life as a savage and, even in an advanced stage of civilization, works important economic results. A single hot wind in Kansas may destroy the crops of the year; a flood in the Mississippi does damage estimated in millions; the date of the first frost may determine the fruit crop for a nation; and a deficiency of rainfall for a few weeks may produce famine affecting millions. Man has learned partially to adjust himself to climate; but he cannot change it, and no other factor within the range of human experience has so much influence, even in minor details, in determining the activities of the human species.

FACTORS OF CLIMATE

110. The factors which exert the chief influence in determining the character of climate are latitude, altitude above sea, the vicinity of the sea, winds, ocean currents, and topography. The influence of these

factors is chiefly felt in their control of temperature and rainfall, — two elements of prime importance to man. The relative predominance of the various factors and the proportions in which they are blended determine for any place its particular climate. Portions of the earth's surface where climatic conditions are sufficiently uniform constitute *climatic zones* or *provinces*, each with its characteristic type of weather and climate, but it will be readily understood that such climatic zones are very complex and, accordingly, difficult of precise limitation. Local variations of climate, due to varying relations between the above-mentioned factors, are to be expected in every part of the globe, and a description which will apply in detail to all parts of a region cannot be given.

111. Latitude. Turning to the individual factors which combine to produce climate, we find that the chief primary element is the distribution of the sun's heat, since this determines the length of day and night¹ and the duration of the seasons ; the amount of heat received from the sun at any given spot depends primarily upon the latitude. If the earth had a uniform surface of water, latitude would be of even more importance as a determining factor, for there would be definite zones of uniform climatic conditions surrounding the world, — zones bounded by parallels of latitude. The warmest climate would be at the equator and the coldest at the poles as now, because the amount of heat received from the sun depends upon the directness with which its rays strike the earth. Within the tropics the noonday sun is always high in the sky and may be directly overhead ; at the poles it appears near the horizon or remains out of sight ; and latitudes between the equator and poles receive amounts of heat corresponding with their position.

Always an element of great importance, latitude was to the ancients the one great cause of climates. Ptolemy divided the earth into 30 *klimata*, — slopes or inclinations. These were zones drawn parallel to the equator and numbered according to the length of a midsummer day, and the corresponding amount of heat. In accordance with this view the earth was marked with the so-called *climatic circles*, namely, the arctic circle, $23\frac{1}{2}^{\circ}$ from the north pole ; the tropics of Cancer and Capricorn, $23\frac{1}{2}^{\circ}$ north and south, respectively, of the equator ; the equator ; and the antarctic circle, $23\frac{1}{2}^{\circ}$ from the south pole. These climatic

¹ In the latitude of England the length of day varies from about 17 hours in July to about 8 hours in January. At New York the extreme difference in length between a summer and a winter day is about 6 hours. The agitation for the "Hours of Day-light" bill is an attempt to regulate clocks in conformity with the varying lengths of day.

circles were supposed to separate the earth into the *torrid zone*, two *temperate zones*, and two *frigid zones*. These terms are still convenient for use, but it should be borne in mind that the factors producing climate are so complex that these circles are of little value as boundaries, and that, in general, the attempt to limit zones of climate by parallels of latitude produces unsatisfactory results. The insufficiency of the climatic circles to bound climatic provinces is well shown by the northern and southern so-called "temperate" zones. They are between the same parallels of latitude, receive almost the same amount of heat from the sun, and, if latitude were the only factor concerned, they should be zones of like climates. The other climatic factors, however, are so important that the north and south temperate zones are extremely unlike in climate. The south temperate zone has uniform conditions; the north temperate zone shows extremes in daily and seasonal ranges of temperature, rainfall, and sunshine, which are hardly less marked than contrasts between the tropics and the poles.

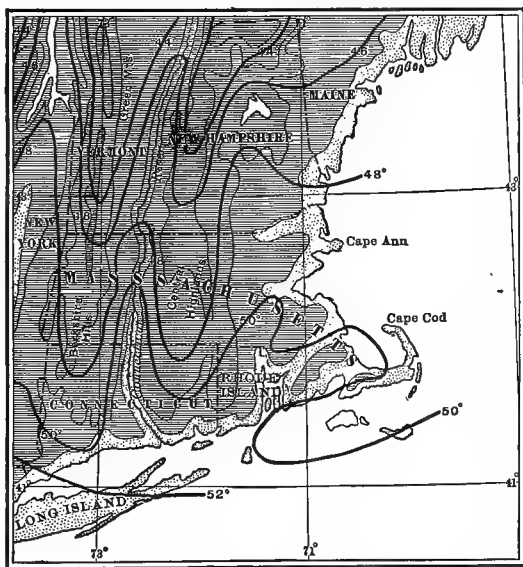


FIG. 17. Influence of Altitude on Temperature

112. Altitude. Elevation above the sea exerts a strong influence on climate in intensifying or overcoming the influence of latitude. The lowest air strata are the warmest, and the highest the least warm, so that mountain tops are perpetually surrounded by cool air. The rate at which the temperature diminishes with height is about 1° for every 300 feet; thus, as one ascends mountains he passes through successive zones of climate. If a mountain of sufficient height is located on the equator, all climates from tropical to polar may be encountered by making its ascent. Thus Ruwenzori (16,815 feet), on the eastern highlands of Africa, is snow capped the year round, while near its base it is surrounded by tropical vegetation of extreme luxuriance.

The peaks which tower above the California desert are flanked with forests and rarely lose completely their mantle of snow. This change from burning heat to constant cold encountered in an ascent of 10,000 to 14,000 feet above a tropic plain would, at sea level, require a journey of a quarter of the circumference of the earth (6000 miles). Elevation above the sea is such an important factor that two places similarly located in reference to latitude, with the same distance from the sea, the same winds, and the same topographic surroundings, may present climates widely different as a result of elevation alone. Elevation plus latitude determine the cold deserts which are permanently uninhabitable. The lower boundary of these deserts is the *snow line*, which is at sea level in the polar regions and becomes higher and higher towards the equator; for example, in Spitzbergen it is 1000 feet; in the Alps, about 9000 feet; in the Rocky Mountains, approximately 12,500 feet; and in the Andes, under the equator, over 16,000. The effect of even a small change in elevation is well shown in the distribution of isothermal lines in New England (fig. 17), where the difference in elevation of a few hundred feet gives a marked change in temperature. It is just such small variations that determine the success or failure of crops.

The fauna and flora of high altitudes, called Alpine, include few species, and those which are found are specifically adjusted to their environment (§§ 133-136). The importance to man of elevation, particularly as a factor in producing healthfulness of climate, is so well recognized that mountain climates are treated as a distinct group (§ 131).

113. Vicinity of the sea. The effect of large bodies of water on climate is very marked and is due primarily to the different manner in which land and water receive the sun's heat. The heat of the sun's rays penetrates the soil with extreme slowness because the particles of soil are opaque and have no movement among themselves. The daily downward heating extends, therefore, but a few feet. In bare sand the sun's heat is concentrated near the surface, the upper layer of only a few inches often being raised to an intense heat, while the sand immediately below is cool, as may be observed on seashores and in desert regions. In forested and grass-covered areas the amount of heat concentrated in the soil is never so extreme. On the water, however, the sun's rays are not stopped at the surface but are communicated downward to a considerable depth. Because the heat is thus distributed, and also because evaporation is constantly dissipating heat, it requires more heat to raise a given amount of water one degree than is the case with most substances. For instance, the heat required to

raise the temperature of a pound of water one degree would produce the same change in nine pounds of iron.

The result of this difference in behavior of earth and water is that water cannot be raised to such high temperatures as the land in its vicinity; and since the temperature of the air is largely controlled by the temperature of the body on which it rests, air over the sea can never be either so cold or so warm as air over land, and regions bordering the sea are therefore much modified by the presence of the water, its tendency being to produce uniform climate throughout the year. The interiors of continents, naturally, are not influenced by these conditions. There consequently arise two types of climate, namely, *maritime*, characteristic of islands and continental shores; and *continental*, characteristic of large interior land areas. Maritime climate tends to uniformity of temperature, with slight differences between day and night and between the seasons. Continental climates are marked by sudden and excessive changes, both daily and seasonal. In fact, the weather changes of a day in a continental climate often exceed those of an entire year in a typical maritime climate. The island of Madeira has a range of only 9° , made up of a winter average of 61° and a summer average of 70° . At Manila (typical maritime climate) the mean annual temperature of 80° rises to 84° in May, the warmest month, and falls to 77° in December and January, the coolest months. In San Francisco the summer average is only 9° higher than that of winter, and most islands and coast lines have an annual range of less than 30° . On the other hand, the interior of the United States, on the High Plains, has a range which is 25° to 55° greater than in the same latitudes on the Pacific; and an annual range of 20° F. (40° to 60°) in England — a maritime climate — may be contrasted with a continental climate having a range of 70° F. (0° to 70°) in the same latitude and at the same elevation in Asia. In England and France the rivers entering the ocean are rarely blocked with ice; while the Oder, in Silesia, is closed for about a month; the Volga, also, is annually ice-bound, and even the salt Caspian is partly frozen over. Lake Baikal, in the latitude of Glasgow (56° N.) is frozen over for many months of the year, although in summer its shores are hotter than the coast of southern France. In extreme cases, as in Montana and Siberia, a daily temperature range of 50° is not uncommon, and the differences between the highest temperature of summer and the lowest of winter in these regions may be as great as 145° . In these cases the climate is made particularly inhospitable by the fact that a change of 100° may be recorded in a few days (§ 119).

114. Winds as a climatic factor. The effects of the climatic factors already mentioned are largely shown in the increase, decrease, or modification of temperature. Winds, also, are of importance in this connection as effective agents in the transference of heat. They effect an interzonal distribution of heat, and were it not for the winds there would be a sharp line of demarcation between the air lying over land and that over sea, in place of the constant interchange now exhibited.

Winds, however, are primarily concerned with the distribution of moisture over the face of the earth. Evaporation from the sea and other water bodies is continually going on, and the air is thus being supplied with water vapor. In the belt of calms along the equator, moisture rises from the ocean during the forenoon and is returned as rain before evening. The movement of air in this case is practically all vertical, and the rain which has been drawn from the sea falls in torrents in the immediate locality. In the climatic belts occupied by the trades and westerlies and also by the less regular winds, moisture is often carried to great distances by air currents. The southeast trades of the Atlantic take up water vapor as they cross the ocean and drop it as rain on the South American continent in regions where the air is sufficiently cooled by elevation to convert the water vapor into rain. Likewise the northeast trades leave no rain on the parched Sahara, but yield up their water vapor on coming into contact with the highlands of Guiana.

In general, it may be said that winds are chiefly responsible for the unequal distribution of moisture over the earth. Winds are also the chief cause of ocean currents,¹ and thereby exert a marked though indirect influence on the transference of heat from one region to another by oceanic circulation (§ 19).

115. Topography. The relative distribution of land and sea and the shape of the land surface are also important climatic factors whose influence is exerted largely in controlling the amount and distribution of temperature and rainfall. The fact that the southern hemisphere is chiefly occupied by water is the fundamental factor which accounts for the differences between the climates of the south temperate and the north temperate zones. The presence of continuous land bodies, like the line from Patagonia to Labrador, modifies the normal circulation of winds and water, gives direction to ocean currents, and interferes with the normal distribution of heat and cold.

¹ The climatic influence of currents has been discussed in a previous chapter (§§ 17-19).

The effect of topography on climate is shown in mountain valleys and also in regions of moderate relief where decided differences in temperature may occur within limited areas. Near the hamlet of Findelen, Switzerland, barley and rye are grown at an altitude of 6900 feet on slopes with southern exposure, but on the opposite side of the mountain, patches of snow lie at a lower altitude than the grain fields on the southern slope. The favorite location for orchards in Canada and the United States is on hills with southern exposure; on the other hand, the vineyards of Cape Colony and the peach orchards of New Zealand are planted on slopes facing the north.

On a smaller scale, the presence of a lake or the trend of a minor valley may influence local temperature and thereby determine the position of farms and the character of the crop to be raised, as is seen in the grape culture of New York or of France. Topographic control is particularly evident in cultivation of specialized "fancy" crops whose high market value depends upon appearance or flavor.

The influence of topography on the distribution of rainfall is, however, even more marked than its effect on temperature. When moist air is forced to ascend, its water vapor is condensed and falls as rain, leaving little to supply the lands which lie beyond. Accordingly, every mountain range and plateau has a wet windward side and a dry leeward side if it is located across the path of prevailing winds. Thus the mountains of Wales have, on their west slopes, at slight elevation, 60 to 80 inches of rain; on the higher slopes, 80 to 100, reaching over 150 inches on Snowdon; while the eastern foothills about Wrexham receive only a little over 30 inches of rainfall. In the trade-wind zone of the Andes the west side of the mountains is scantily supplied with rain, while the east side is constantly drenched; in the southern Andes in the belt of the westerlies, these conditions are reversed. The highlands of Bolivia and Peru, the Great Basin of Utah and Nevada, and the central plateau of Asia with the Gobi desert are illustrations of arid lands whose supply of water is cut off by obstructing mountains. Even minor variations in topography may produce important results. Thus measurements taken in the valley of the Tweed in connection with the water supply of the city of Edinburgh show that under similar conditions of exposure, but at different altitudes, there was an increase of 2.5 inches of rainfall in each 100 feet of increase in elevation.

The relation of topography to rainfall is especially well exhibited in California and Nevada (fig. 18). The water vapor here is brought by the westerlies, which pass over the low Coast Range, across the wide

Sacramento valley, and up the slopes of the Sierra Nevada to elevations of 10,000 feet, then down to the Great Basin (§ 68). Beginning on the coast at the Farallon lighthouse, with 18.44 inches, the rainfall increases on the Coast Range at San Francisco to 22.77, then decreases on the lowlands in the lee of those mountains. On the slopes

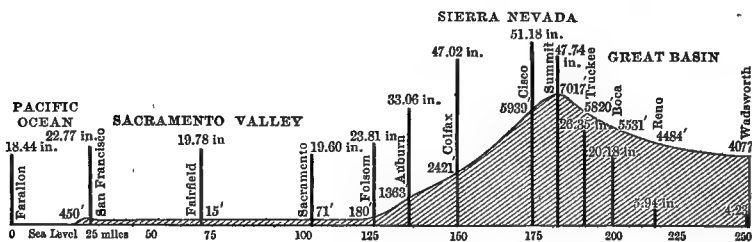


FIG. 18. Relation of Topography to Rainfall

of the Sierra Nevada the precipitation again increases to 51.18 inches at Cisco, dropping to 47.74 inches at the summit. After passing the summit the decrease in supply back of the mountains is very rapid, for the rainfall drops on the Nevada side to 5.94 inches at Reno and 4.23 inches at Wadsworth.¹

ELEMENTS OF CLIMATE WHICH MOST DIRECTLY CONCERN MAN

116. General statement. The climatic factors above described determine the atmospheric conditions to which plants and animals must adjust themselves (§§ 133-136 ; cf. §§ 143-145) in order to maintain a footing in any region. These factors combine to determine three elements which bear most directly upon the life of man, namely, temperature, rainfall, and the distribution of temperature, rainfall, and sunshine throughout the year.

117. Effect of the atmosphere on temperature. The temperature of space outside the atmosphere is probably the "absolute zero" (-273.7° C.), and it has been calculated that if the atmosphere were removed, the mean temperature of the earth's surface would be 115° F.; reaching 350° in the daytime and dropping to 123° below zero at night. This would give a daily temperature range of 473° , a condition which would make plant and animal life impossible. Thus we see that the effect of the atmosphere is to retain heat near the earth and to prevent enormous extremes.

¹ Hamlin, "Water Supply and Irrigation," *Paper No. 89*, United States Geological Survey.

118. Zones and temperature. The temperature of many places on the earth's surface has been determined by observations, and its distribution may be approximately shown on a map by means of isotherms, that is, lines drawn through places of equal temperature, — annual, monthly, or seasonal. Examination of an isothermal map¹ will show that isotherms are not straight lines parallel with the equator, but that they are extremely irregular, thus expressing graphically the fact that many factors contribute their influence in determining the temperature of a given place. As might be expected, isothermal lines are seen to be most regular in the southern hemisphere, particularly over the ocean, where they nearly coincide with parallels of latitude. In other parts of the world, and particularly over land, there is but slight agreement between the two sets of lines. On a chart of mean annual temperature for the year, the most marked variation is seen to be produced by ocean currents and westerlies, which in the northern hemisphere bring a proportionately larger amount of heat to the east side of oceans than to their west shores. The same effect is felt south of the equator. If we compare the isotherms for January and July we see that in winter they bend toward the equator on the land and away from the equator over the sea, and that in general the lines over water bodies are more uniform and regular than those over land, showing the temperature of the land to be characterized by variation and that of the water by uniformity. Furthermore, we notice that the mean annual temperature of a place changes little from year to year. Thus at Geneva, Switzerland, the highest mean annual temperature for 20 years was 51.6° , and the lowest 49.9° , — a difference of 1.7° . New Haven has a January temperature of 28° and a July temperature of 72° , with only slight variations in 100 years. Places with the same mean annual temperature may be grouped into zones whose boundaries are isotherms. The *torrid zone* lies between the annual isotherms of 70° on both sides of the equator and the *temperate zones* between 70° and 30° . The *frigid zones* at the earth's poles are inclosed by the isotherm of 30° . The zones of temperature are not fixed in position, but shift back and forth over the equator with the changes of the sun's position. The amount of shifting is irregular but not usually very great, so that certain parts of the earth may be marked off as being always hot or always temperate, while other regions are characterized by cold winters with temperate summers, etc. The map (fig. 19) shows the location of these roughly defined zones.

¹ Such maps appear in text-books of physical and commercial geography and in all good atlases.

119. Temperature ranges. The range of temperature is the difference between high and low thermometer readings for a given place. Records may be grouped to show the *mean annual range*, that is, the difference between the mean of the coldest month and the mean of the warmest month; or the *daily range*; or the *seasonal range*; or the *absolute temperature range*, that is, the difference between the highest and lowest temperatures ever recorded at a given place. The daily range of temperature, due to the rotation of the earth, and the seasonal range, due to its revolution; and the temperature extremes, due to the combined influence of several climatic factors, are more important to mankind than the mean annual temperature; for just as it

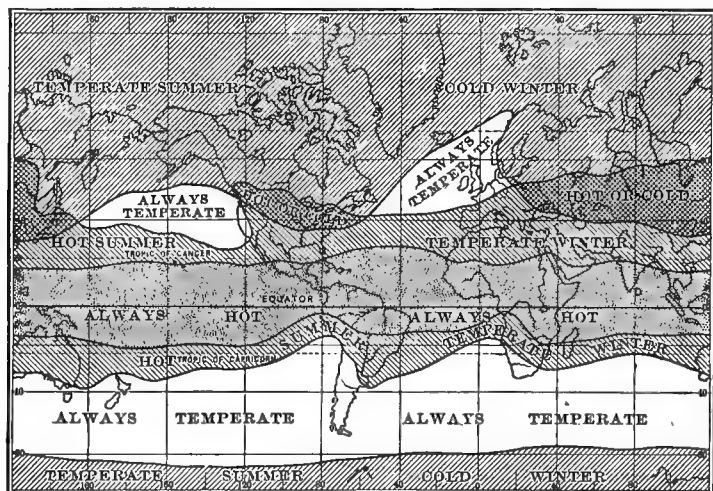


FIG. 19. Zones of Temperature. (After Dryer)

is necessary to build levees for the highest floods — not the average ones — and to construct sea walls to meet the extraordinary wave which may come but once a year, so plants and animals are not adapted to a given climate unless they are prepared to meet its most excessive variations. Vegetable and animal forms live and flourish in widely different temperatures after they become adjusted (§ 136), but sudden and violent changes of climate are extremely difficult to endure. The deep-sea fish would probably be exterminated if the water on the sea bottom should change more than 2° ; peach trees would die if the winter season were slightly colder than the normal; and if the climate at Minnesota were transferred for one year to the Amazon basin, that region would be swept practically bare of plant and animal life.

The mean annual range of temperature varies from 120° in north-east Siberia to less than 10° in certain continental islands; for most of the southern hemisphere it is under 20° , while half of the land masses in the northern hemisphere attain an annual range of over 60° . For instance, Port Stanley, on the Falkland Islands (lat. 51° S.), has an annual range of $13\frac{1}{2}^{\circ}$ (June, 36° ; February, 49.5°), while Greenwich (lat. 51° N.) has a range of 24.8° (January, 38.8° ; July, 63.6°). The influence of the sea on annual range may be seen by comparing Verkhoyansk, Siberia, with Iceland. Both are near the arctic circle, but Verkhoyansk has a range of 119.8° (January, -61.2° ; July, 58.6°), while the mean annual range of Iceland is 18.5° (January, 27.1° ; August, 45.6°). Certain localities are much warmer or much colder than would be expected from their position. Thus, in January north-east Siberia is 30° colder and northwest Europe 35° warmer than their location would seem to warrant; and the Hudson Bay district is 25° colder in January and 20° warmer in July than would be expected from its position.

The minimum annual temperature for the world is -76° F., recorded at Verkhoyansk, Siberia, and the lowest actual temperature observed in this locality is -89° F. In the Great Bear Lake region of North America the thermometer records an annual minimum of -58° , and an actual temperature of -72° has been measured. In the Yukon Valley a temperature of -68° has been recorded, in Greenland -76° , and a minimum temperature of -63.1° has been registered in northern Montana. On the other hand, a temperature of 68° and above is maintained throughout the year in a restricted area on the Guiana coast of South America, on the African coast from Arabia to Zanzibar, and in a strip across the Indian and Pacific oceans, including Ceylon, Sumatra; Borneo, and Java. Areas where an annual maximum of over 113° is expected, include a strip from the western Sahara across Egypt, Persia, and northwest India, and the southwest border of the United States in New Mexico, Arizona, and California, as well as central Australia in the southern hemisphere. The Sahara and Death Valley (1891) reach the extreme temperature of 122° ; Arizona, 119° ; and temperatures of 112° to 115° are not uncommon in the Gila Valley and the Mohave Desert. The extreme annual range between the lowest and highest records for the southern hemisphere is 81° ; for North America, 153° ; for northern Asia, 171° ; and the difference between the highest and lowest temperatures ever recorded is 180° , — equal to the difference between the freezing and boiling points of water. The importance of these temperature ranges is seen when two places

with the same mean annual temperature are compared; thus, San Francisco and St. Louis have a mean annual temperature of 56° , but the climate of the two places is very different; the variation between the coldest and warmest months in San Francisco is 11° ; in St. Louis, 47° ; and the extreme annual ranges of the two places are, for San Francisco, 71° ; and for St. Louis, 123° .

The suddenness with which temperature changes take place is also an important matter to man, and accordingly daily temperature ranges must be taken into account. The surface water near the equator varies hardly 0.7° during the day, and the annual range on the sea near the equator is not much greater than the daily range. On land, however, the mean daily range may be larger than the mean annual range. At Equatorville, in the interior of Africa, the daily range is 14.5° , and the annual range 2° . Key West sometimes shows as little as 7° in its daily variations, while western arid regions may have a change of 40° or more, from day to night. In December, 1880, there was a change of 117° in Montana in 17 days; Texas has a record of a fall of temperature of 63° in 16 hours; and in Tibet the thermometer recorded a change of nearly 90° in one day, from 68° at noon to -22° at night. A temperature drop of 60° to 70° within a few days may accompany anticyclones of continental interiors.

120. Rainfall. The amount of rain received by a region determines in large measure the possibility for plant life and, accordingly, the chance for man to live in that region as an agriculturalist. Moisture is absolutely necessary for plants (§ 76), and, generally speaking, the amount of rainfall determines the character and luxuriance of vegetation. Plants can adjust themselves to a very small amount of water, just as some seeds can germinate on ice, but to produce plants useful for food there must be a reasonable rainfall; and if agriculture is to be carried on without expensive artificial irrigation, the precipitation must, under ordinary circumstances, in temperate latitudes, approximate 20 inches per year.

The production of rain requires a body of water from which moisture can be evaporated, air movements to distribute the moisture, and some cooling agency to condense the moisture and make it fall. The first condition is chiefly met by the sea, the second by prevailing winds, and the third by highlands, mountains, and the cooling effect of the expansion of the air in cyclonic areas (§ 105). Temperature, winds, topography, and air pressure are therefore the chief elements concerned with rainfall, and, in accordance with the relative efficiency of these factors, a rainfall map of the world is covered with a series of

irregular patches indicating the amount of precipitation. The recorded extremes occur in the Salton desert, California, where less than one tenth of an inch has fallen in a year, and in Assam, which receives over 500 inches. In spite of the great variability both in amount and frequency of precipitation, and the apparent irregularity of its distribution, there are nevertheless some underlying principles which may be borne in mind :

1. High latitudes and high altitudes have small rainfall, because the temperature of the air is too low to allow it to contain a large amount of moisture. Thus central Greenland, Spitzbergen, and northern Canada have less than 10 inches. The highlands of the world above 10,000 feet are, in general, dry.

2. When winds blow across steeply rising mountains, the precipitation is usually heavy on the windward side, for the moisture carried by winds is deposited within a narrow zone, leaving one side of the mountain chain wet and the other dry. Vera Cruz, on the Gulf coast of Mexico, has 67.9 inches of rain yearly ; Córdoba, on the mountain flank, 112.9 inches ; Mexico City, 22.9 inches ; and Pachuca, 8.3 inches. At Hokitika, on the west coast of New Zealand, the rainfall is 112 inches ; but at Cape Campbell, on the northeastern coast, it is 21 inches. The highlands of Ireland, Scotland, and Norway, the Lepontine Alps, and the mountainous regions of Spain, Austria, and the Caucasus act as condensers.

The position of mountains also accounts in part for the excessive rainfalls of the world. The heaviest rainfall would be looked for where the warmest winds from the ocean come into contact with cold mountain areas, a condition found in the monsoon district of India. At the base of the Khasia hills, the average precipitation is 464 inches per year, some years over 600, and at Cherrapunji, Assam, in 1861, the world's record rainfall of 905 inches (over 75 feet) was recorded, practically all of which came in five months.¹

3. Where trade winds blow against land masses abundant moisture is precipitated ; elsewhere throughout their course the rainfall is light. The position of these winds, indeed, is an important cause of deserts (§§ 124-125) and, taken in connection with the position of mountain chains (see 2, above), explains the distribution of most wet climates and of regions of extreme aridity (§§ 114-115).

4. In the equatorial belt, precipitation is uniformly heavy, and as this belt migrates with the heat equator, there is for any given place

¹ The failure of the monsoons, 1876-1878, caused a famine, with a loss of 5,000,000 lives.

in the tropics a dry season and a wet season, depending upon whether the trade winds or the zone of calms is exercising paramount control. During its northward migration the equatorial rain belt supplies the Nile, the Niger, and the Orinoco, while the Congo and the Paraguay are abundantly supplied when the rain belt moves southward. So dominant is the rainfall as a climatic factor within the tropics that the seasons are known as *wet* and *dry* instead of the spring, summer, autumn, and winter of regions where temperature has greater influence.

5. Rainfall is heavier near the coast than in the interior of continents. The Washington-Oregon coast has the heaviest rainfall in the United States, — over 100 inches, — followed by the Mississippi and Carolina coast lines with 60 inches. In Europe the yearly precipitation at Utrecht, near the coast, is 27.5 inches; at Berlin, 22.8 inches; and at Orenburg, 2000 miles inland, 14.1 inches.

6. Rainfall conditions are uniform in the tropics, fairly regular in the arctic and south temperate zones, but very irregular in the north temperate zone.

121. Distribution of temperature, rainfall, and sunshine throughout the year. From the standpoint of commerce and of agriculture it is not enough that the factors of climate should be sufficient in amount; there must also be a favorable distribution of these factors, if the activities of man are to produce successful results. Attention has already been called to the fact that animal and plant life are closely adjusted to their environment, and that great changes and, especially, sudden changes of any kind are difficult to bear. For example, 20 inches or less of rainfall is sufficient for agriculture if properly distributed, but it is insufficient if it comes at the wrong time of the year. On the other hand, abundant crops have been raised with 12 inches of rain, all of which came during the growing season. The amount of rain, therefore, is not so important as its distribution. Jerusalem has 26 inches of rainfall, about the same amount as London, and more than is received by the great wheat fields of Minnesota and Dakota; 21½ inches of it falls, however, during December, January, February, and March, and only one-half inch during the growing season, — April to July. Italy and Greece receive a fair rainfall, but its distribution is such that prolonged droughts occur in summer and irrigation becomes necessary. The United States has a moderate amount of rainfall, which is so distributed as to be particularly effective in the growing season. In Florida and Georgia the heaviest rainfall comes in June, July, and August; in Arizona and New Mexico 35 per cent

of the rain falls in July and August; and in Montana 33 per cent in May and June. The critical months for agriculture in the United States are April, May, June, and July, and during those months the great central valley north of latitude 35° receives 30 to 50 per cent of its annual precipitation, thus insuring not only the growth of crops but also large productiveness (§§ 217, 218).

The number of cloudy days is also an important climatic element, for it affects the distribution of plants, the healthfulness of climate, and, indirectly, exerts an influence on human disposition and character. In Europe there is an increase in sunshine from west to east and from north to south. York, England, receives 28 per cent of its possible sunshine; Rostock, 38 per cent; and Irkutsk, 50 per cent. Central Germany has 38 per cent; Austria, 40 to 45 per cent; Italy, 45 to 54 per cent; and the interior of Spain, 66 to 68 per cent. In northern England and northern Germany the sun rarely shines more than 25 hours during the whole month of December, while the Mediterranean coast receives four times as much sunshine within the same length of time. The amount of sunshine for the United States averages above 50 per cent, reaching 70 per cent in Arizona and 20 per cent about Lake Erie. Toledo has 136 days of rain and cloud during a year; Buffalo, 169; and Volney, New York, 195. In the Rocky Mountain regions and the high plateaus the number falls to 70, and the Pacific coast has 66 such days at San Francisco and 42 at San Diego, reaching a minimum of 13 at Yuma. Sitka, on the other hand, has an annual average of 224 days without sunshine, and Unalaska has 250.

ZONES OF CLIMATE

122. Zones of climate are areas in which similar weather conditions prevail. They are not identical with zones of temperature, wind zones, or belts of rainfall, but are the result of a combination of all the factors which determine climate.

123. Equatorial zone. The *equatorial zone* is a belt about 30° wide, characterized by low atmospheric pressure, by calms, and by abundant rain. The temperature is always warm, averaging over 70° , and the annual mean isotherm of 85° is included in this belt. The annual range of temperature is small, usually under 10° , in some places less than 5° . In fact, the daily range is usually larger than the annual, so that it may be considered that "night is the winter of the tropics." True seasons, based on temperature, are unknown. Rainfall and prevailing winds determine the subdivision, and the life of plants and animals,

including man, is controlled almost solely by these factors. In this belt are many of the heavy rainfall regions of the world; an average for the whole zone would be perhaps 100 inches. Drought, as well as frost, is unknown. As this equatorial zone of rains and calms shifts back and forth across the terrestrial equator under the sun, it gives to localities near the equator two rainy and two dry seasons. In brief, the climate of the equatorial zone is sultry and humid; it has constant and abundant rains, and very marked daily rather than seasonal changes. Vegetation in this zone is the most luxuriant in the world, in fact, so luxuriant that it has been impossible for man to subdue it, and some of the least settled sections of the world are therefore those supplied with the richest vegetable life. Even to this day parts of equatorial South America have not been explored (§§ 149, 150).

124. Trade-wind zones. In the region occupied by the trade winds (§ 101) both north and south of the equator the sky is bright, the air fresh, and there is no marked change of seasons. The winds blow constantly and regularly with fairly uniform velocity from about latitude 28° north and south of the equator; their influence, however, is felt as far as latitude 40° . This is especially true in southern Europe, where the hot low-pressure area of the Sahara drains the air from the Mediterranean countries. The northeast and southeast trades become warmer as they approach the equator, and, accordingly, are able not only to hold their water vapor, but also to take up moisture from the land or sea over which they pass. This moisture is precipitated where the cooling effect of highlands is felt. Thus the trade zone is characterized by extensive arid regions and regions of heavy rainfall (§§ 20, 125). When the entire wind system shifts north or south of the equator (§ 103), this trade-wind belt is carried with it, and rainy and dry seasons are accordingly given to districts outside of the equatorial regions. In the arid section of the trade-wind zone are the deserts of Africa, Arabia, Australia, and South America, where the dust-laden wind retains its moisture which is destined to be carried to the lands under the equator.

A modification of the trade-zone climate is seen in the monsoon belt which extends over a large area adjoining the Indian Ocean, including Borneo and reaching even to the Japan Sea on the north. The summer monsoon period is characterized by warm moisture-laden winds which come into contact with the land areas of southern Asia, producing a sultry, rainy season. During the winter monsoon the region is in control of the trades, and a dry, cool climate prevails (§ 103).

In brief, the trade zones are characterized by fair weather, steady winds, and slight changes of annual temperature. Rainfall at sea level is infrequent or absent; the lowlands are deserts, and the highlands in the paths of the winds are subject to heavy rain. Over the ocean the trade climates are the most uniform known.

125. Deserts. A rainfall map of the world reveals the fact that deserts are not distributed in haphazard fashion, but that they are located along the tropics or in the lee of mountain masses, and that, as to origin, they fall into two groups, as follows:¹

1. Deserts located in the zones where the trade winds originate; where moisture is taken up but not redeposited (§ 124). The north-east trades are chiefly responsible for the deserts of Arabia, Sahara, and, in less degree, for those of lower California. The southeast trades produce the desert area of West Australia, the Kalahari Desert of Africa, and the Atacama Desert of Chile and Peru. Small islands in the path of the trades are arid, like St. Helena, many of the Bahamas, the smaller members of the Galapagos group, etc.; the larger ones have wet and dry sides, as Hawaii and Madagascar.

2. Deserts on the leeward side of mountains. Any inclosed basin is more or less arid, as exhibited by Bohemia, the Hungarian plain, and the great Po valley; and in places where not only the mountain borders but also the inclosed area is at a considerable elevation, precipitation is greatly decreased. Thus the west coast of Spain receives 60 inches of rainfall, while the central plateau is arid (20 inches). Vancouver is plentifully supplied with rain, while eastern Oregon receives less than 15 inches each year. For the same reason, Peru and central Australia are arid, and the great Gobi and other deserts of central Asia are deprived of a water supply. The climatic condition of southeastern California is in part due to this cause.

The temperature ranges of deserts are great, especially on continental interiors, and, in fact, these deserts might be considered as extreme types of continental climates (§ 113), with corresponding extremes of plant and animal life, and with characteristic topographic forms. Such dry climates are sparsely inhabited by plants and animals which have been adjusted to the unusual conditions found there (§§ 133, 136, 138-140). Plants are provided with long roots to take up moisture and with thick bark and small leaves to prevent evaporation; and they are usually protected by thorns or poisonous juices. Animals likewise have developed structures to assist them in their

¹ Deserts may be produced by extreme cold as well as by excessive aridity, but only the latter class is here discussed.

desert environment. They are either swift or poisonous and have uniformly the capacity to go for long periods without water. Thus the slow-moving tortoise, as well as the camel, has developed organs for carrying an extra amount of water.

When water is supplied, deserts may be favorable regions for settlement, for the heat, though great, is not oppressive, and the air is singularly pure and free from disease germs. In spite, however, of the most elaborate irrigation enterprises, these districts are doomed to scant population. Oases in deserts are not the "paradises" of fiction, but merely regions where conditions are relatively more favorable. Even here the water supply is limited and often unpalatable, and sand storms, too, must be endured. Habitable oases are not numerous in hot climates, and stretches between "water holes" in deserts are often too great to be traversed except by a well-organized expedition. The first important station west of Cairo in the Saharâ Desert is the oasis of Siwa, 350 miles distant. The lack of water in the deserts of North America is such that the early immigrants, even under most skillful guidance, suffered hardship and even death, and to this day travel in parts of Arizona, California, and Nevada is difficult and even dangerous.

126. Transition zones. A *transition zone* of high pressure (horse latitudes, § 101), marked by calms and variable winds, lies between the trades and the temperature zones. The shifting of the wind belts brings this region alternately in control of the trades and of the westerlies. Such regions are too far from the equator to receive abundant rains and are out of reach of the storms of the westerlies. They therefore have a unique and agreeable climate. The rains come in the winter and are not excessive in amount, and the summer has continuously fair weather. Such regions are noted as health resorts; they include southern California and practically all of the Mediterranean shores of Europe and Africa.

127. South temperate zone. The *south temperate zone*, between the horse latitudes and the polar areas, is a region of strikingly uniform climatic conditions. Being almost entirely a zone of water, all the factors of climate, except the vicinity of the sea (§ 113), are minimized. Summer and winter are only moderately developed, the seasons consisting rather of a few days of stormy weather followed by a few days of unusually fair weather; and extremes of any kind are rare throughout the zone.

The prevailing winds are the westerlies, — the "brave west winds" of the sailor, which are constant and much stronger than the trades.

A cloudy sky is very common, and in the southern part of the belt snow may occur in any month of the year. Typical south temperate weather conditions are exhibited by the smaller islands of this zone, whose cool summers are followed by slightly colder winters, giving a monotonous and unattractive climate. South Georgia, in the latitude of England, is singularly inhospitable.

128. North temperate zone. The *north temperate zone* extends from the isotherm of 68° to the isotherm of 30° . The name "temperate" is peculiarly inapt as a description of this belt, for it is, in fact, a zone of the most marked extremes in winds, rainfall, temperature, and variety of climatic details. The winds of the north temperate zone are the "stormy westerlies," much less regular than the trades, or the westerlies of the south temperate zone, and much more interrupted by cyclonic storms. The rainfall over a large part of this zone is 20 to 80 inches, and it is controlled in its distribution by cyclones and topography (§§ 106, 115). The differences in temperature between the hottest and coldest months reach 120° in Siberia and 80° in North America, and many of the coldest and some of the warmest lands are within this zone. Attention has already been called to the fact that many regions included in it have temperatures much above or much below the normal (§§ 117, 119).

The north temperate is the only zone which has a division of the year into four seasons, — spring, summer, autumn, and winter, — a division based on differences of temperature. This fact has an important bearing on the development and adjustment of plant and animal life, and there seems to be direct causal relation between such a climate which tends to stimulate activity and the presence of the great civilized races of the world in the north temperate zone. Seasonal changes encourage physical and mental initiative; food may be secured in this zone, but not without labor; forethought is essential, yet life is not too hard, as in the polar climates, nor too easy, as in the tropics (§§ 147–148, 172 ff.). Within this zone the distribution of temperature and rainfall and sunshine is so complex that the variety of plant life and animals and men exceeds that of any other part of the earth.

129. Polar climates. The polar climates are characterized by the presence of two seasons, — a winter of ten months and a summer of two, with a sudden change from one to the other. There is no warm season, and daily weather changes are practically unknown. A rainfall of about 10 inches is supplied by strong humid winds which are especially unfavorable for plants and animals.

130. Climates of east and west coasts. The climate of the eastern coasts of oceans outside of the tropics is much more uniform and equable than that of western coasts on the same parallels of latitude. This is due to the fact that the winds, together with the ocean currents, carry heat to the northeast in the northern hemisphere and to the southeast in the southern. England, in the latitude of Labrador, is a garden spot; Labrador is almost uninhabitable; the warm districts of Spain and Italy are on about the latitude of New York. The harbor of Hammerfest, lat. 70° N., is not ice bound, while the harbors on the east coast of the United States, as low as latitude 40° , may freeze over. The climate of western Europe is much like that of the south temperate zone, while eastern North America has the variations characteristic of the north temperate. In a small way the same difference is seen on Lake Michigan, whose east shore is "tempered" by the lake waters.

131. Mountain climates. Owing to the effect of elevation as a climatic factor, mountain climates may be grouped as a distinct subdivision. If high enough, their tops have polar climates, even in tropical regions; at moderate heights they furnish delightful climates, — clear and dry in winter, moist in summer. Emigrants from colder latitudes may find their home climates in the tropics at certain elevations. Thus India is ruled from 7000 feet above the sea, and Bogotá, Colombia, in the equatorial zone, has one of the most delightful climates known. The life of tropical man, — his agriculture, arts, institutions, etc., — forms a fascinating study in relation to environment¹ (cf. §§ 147, 175 ff., 198).

132. Changes of climate. That the earth has undergone great climatic changes during its history is proved by geological evidence. Tropical plants once grew in Greenland, and forests of luxuriant ferns and palms occupied the area which is now called Pennsylvania and West Virginia. During the glacial time the whole northern part of the American continent was covered with ice.

Important changes have also taken place in recent times. In Turkestan and Persia there has been a gradual desiccation during historical times. Village sites are found in the midst of desert regions, and there is evidence that the people moved upstream as the water gradually decreased. At first, irrigation was practiced, then, as the water supply decreased, the fields were abandoned. There is little evidence of a progressive change of climate at the present time toward cold or warm, dry or wet; but the existence of cycles of changes appears

¹ For an account of the controls exercised on man by types of climate, see Ward's, *Climate*, Chaps. VIII-X inclusive.

from a study of meteorological records. There is a climatic cycle of 11 years which corresponds with the increase and decrease of sun spots. A cycle of 35 years is also indicated by researches over a large part of the world, a period during which comes a series of cold or rainy years, followed by years which are warmer or drier. For instance, western Kansas, Nebraska, and eastern Colorado were settled near the close of a wet period (1880-1890), only to be abandoned as the dry cycle came on, and reoccupied as the supply of water increased.¹

¹For a discussion of this subject and the bearing of climatic cycles on history, see Huntington's *Pulse of Asia*, *Climate of Ancient Palestine*, etc., and Bowman's "Man and Climatic Change in South America," *Geog. Jour.* (London), March, 1909.

CHAPTER VI

THE ORGANIC ENVIRONMENT

133. Adaptation to environment. Beside that section of the physical environment which might be called inorganic, and which has now been described in its several most significant phases, there exists yet another section, the organic. The influence of the flora and fauna of a region upon its human inhabitants is, as will be seen (§§ 149 ff.), unquestionably very great ; and with a view to understanding the type of life lived by man in various parts of the world, it is necessary to treat somewhat of the natural distribution of plant and animal forms. The explanation of this distribution will also constitute the general case under which can be ranged the more complicated instance afforded by man's distribution (§§ 172 ff.).

What we desire at present to know about plant and animal life over the earth is, briefly speaking, how such variety came to exist. From a multitude of observations it is found that plants and animals are somehow adapted to the natural environment in which they live : desert flora will store moisture and do not easily lose it, polar animals have thicker and longer fur than their congeners of warmer zones, — it is often white in color, or even changes color with the seasons, — and so on. To catalogue the correspondences between organic life and the inorganic environment would be an endless task ; certain typical cases, besides, will occur when we come to consider the influence of flora and fauna on man (Chapter VIII). It is more profitable here to outline with brevity the general causes which lie behind the production and distribution of the several types of flora and fauna.

134. The struggle for existence. First of all, organic life is subject to increase at a geometrical ratio — to an increase so rapid that the slowest reproducing of organisms would speedily fill up the earth with their offspring were there no hindrances to their multiplication. An annual plant producing only 50 seeds a year would become the ancestor, in the ninth year, of some 1,950,000,000,000,000 plants ; if each of these occupied one square foot of soil, the whole surface of the globe would then be occupied, and some 500,000,000,000,000 seeds would be left

over with no place for their growth. Animals producing ten pairs annually to each pair (each animal living ten years) would show over 700,000,000,000,000,000,000 pairs alive in the twentieth year. Yet these rates of possible increase are not large : consider the number of acorns on the oak, or of eggs in the roe of fish. But with all this possibility of increase we know that such accession does not take place ; in general, the numbers of the plants and animals, taking them, say, over a hundred years, fluctuate around an average ; they are now greater, now less, but in the long run stationary. Hence we must infer a tremendous death rate of all organisms ; but since the first business of any organism is to live, death will not be accepted without a struggle. Plants will choke each other out ; and animals, with a more generally recognized "instinct for self-preservation," will not succumb while there is a chance to resist. This is the *struggle for existence* ; and it is so severe, as can well be conceived, that even a slight natural advantage or disadvantage may decide the issue of life and death. Weakness of any kind may prove fatal ; hence any group of organisms, which even though they weather the struggle for a time, yet do so at a sacrifice of strength, have no surety as the competition renews or grows fiercer (cf. §§ 138-140).

135. Survival of the fitter. But no two organisms really have the same chance in this struggle, for no two are alike. There are two factors in life which operate, the one to render offspring different from parents and from each other, and the other to keep the type the same. The former is *variation*, the latter *heredity*. Heredity produces its effects by transmitting ancestral variations more or less perfectly from generation to generation ; thus, while offspring vary, sometimes slightly, sometimes greatly (mutations), from parents, in general they all belong to a single type with certain more or less unique characters. Armed now with these principles, let us return to our struggle for existence. Certain types will prevail because of certain characters which enable them to fit into the environment and endure its conditions ; the rest will die or degenerate. The survivors will produce the next generation, which will tend to possess by heredity the winning qualities in the struggle — which never ceases. Those of the second generation possessing the most marked variations in the happy direction will again survive and breed, and so on. This is, of course, an age-long process. Thus will the possession of the fortunate qualities be fixed and their degree of advantageousness be increased. Those organisms which possess these qualities will be better adapted to live ; in their persistence will be seen the *survival of the fitter*.

Of all the bear cubs born in a cold region some will tend to develop coats warmer than those of others; their chance to live is greater; they will tend to produce young which show the same variation toward better protection. Under severe competition in the struggle for existence we should, perhaps after some centuries, have a development of the thick, long fur characteristic of the polar bear. This type would be the fitter.

136. Modification and adaptation. If, now, it is the fitter organisms which survive, then, should the environment be changed, in order to remain fit the successful organisms must undergo further modifications of structure. In short, the whole process which has been sketched leads up to structural modifications on the part of plants and animals, to changes calculated to set them, or to keep them, in harmony with their natural environments. The whole of the above is briefly resumed in the following (Wallace's) chart of the evolutionary process¹:

<i>Proved Facts</i>	<i>Consequences</i>
A. Rapid increase of numbers	} Struggle for existence
B. Total numbers stationary	
C. Struggle for existence	} Survival of the fittest [fitter]
D. Variation with heredity	
E. Survival of the fittest [fitter]	} Structural modifications
F. Change of environment	

Now it is precisely these structural modifications upon which the various genera, species, and varieties of plants and animals are distinguished; that is, these adaptations to environment are what make the type or character of the organism. Here, then, we have the *how* of the matter of plant and animal differences, whereby — to keep in mind our especial interest — the lower organisms are able to affect in one peculiar way or another the life of man; whereby they constitute a condition of human environment, varying in different localities.

137. Dispersal. A single alternative in the struggle for existence stands over against death, degeneracy, or adaptation; and that is flight. The migration of birds with the seasons is only a swifter flight than the slow movement of forests along with temperature belts, during geologic ages. Rather than die or adapt, the arctic plant has ascended the upper ridges of tropical mountains, and the ancient animals, now of a polar, now of a tropical type, have deserted central Europe. But

¹ The teacher will appreciate the fact that so brief a sketch of so large a subject as is attempted in the present chapter must be greatly condensed; and that much which is implicit in the above chart, and in the several paragraphs of the chapter, should be made explicit in the class-room discussion.

That the evolutionary process does not result in superlative but only in comparative fitness is indicated by the bracketed emendation of the chart.

flight has not always been the destined alternative ; under the impulsion of some necessity, or because there was, after all, less resistance along the way of adaptation than otherwise, plant and animal life has, through the ages, penetrated all possible regions of the globe, and, becoming adapted to this and that environment, climatic and other, has come to constitute the characteristic types of various regions. The *how* of this diversification, so wide reaching in its influence on man, is now explained, at least in its most general outlines. Something of the influence upon man of this diversified organic environment, — itself so dependent upon the “ inorganic,” — as well as something of man’s own form of adaptation, rendered more easily explicable now that the process of plant and animal adaptation has been indicated, will come before us in the succeeding chapters.

PART II

RELATION OF MAN TO NATURAL CONDITIONS

INTRODUCTORY NOTE

The study of Part I of this volume will have acquainted the student with the main features of natural environment, especially with those which exert a strong and constant influence upon man — and so upon trade. Into this environment it is now proposed to introduce man, and to show how his life is conditioned by the factors of which an account has been given. It is manifest to one who has given but superficial attention to the influence, direct or indirect, of natural environment, that we can no more than sketch the most general and universal of these life conditions. Influence of natural environment is all-pervasive ; but to attempt to pursue it into its finer ramifications would be to immerse the reader in a mass of detail from which he would very likely emerge with scarcely greater profit than from the consecutive reading of the dictionary.¹

The next section of the volume will be devoted, therefore, to the most broad and general influences of natural environment upon man. And since man is an organic being, like those whose life and distribution have been studied, the method employed will consist largely in the application to man of the evolutionary reasoning just now (§§ 133 ff.) applied to the plants and animals. But, as any one can perceive with a little reflection, the cases are not absolutely similar; our main concern will be to show how the case of man differs from that of the flora and fauna by reason of the fact that he is so much more highly developed in brain power than are the lower organisms.

¹ Geographers and anthropologists have given much attention to the relations of human societies to their regions. It is in the power of the teacher to interest students in the gathering of instances bearing upon the contentions set forth in succeeding chapters.

CHAPTER VII

HUMAN ADAPTATION. ENVIRONMENTAL INFLUENCES

138. Necessity of adaptation. Every alteration of any importance in their environment sets before the animal or plant, as has just been seen, a series of alternatives : death, degeneration, flight, or adaptation. What is the fate of man, the so-called highest of the animals, under the same conditions ? It is well known that men die when natural conditions become unfavorable enough ; famines recurrently sweep many from the earth. Again, they degenerate when they are forced to live a life that is possible to live, but only in a miserable way. Some of the lowest tribes of men, like the South African Bushmen or the Digger Indians, have been forced by stronger tribes to withdraw into the desert and to exist upon a lower plane of life. The physique of such peoples betrays the hardships which they have suffered. Men also flee from an unfavorable environment, thus escaping death or degeneracy, if the way into a more favorable locality lies open for them. Much of migration and colonization comes under this alternative. The abandoned farms of New England furnish illustration of this topic : their former owners may be in the West, in the cities, or elsewhere where effort wins a subsistence or a comfort impossible under the old conditions. The Italians and other foreigners who are taking up these abandoned farms, whose ideas of a satisfactory standard of living are not so ambitious, may represent the level of life to which the emigrants were unwilling to descend.

The alternative of adaptation remains ; and this is the one which, for the time, occupies our attention. An animal species, instead of pursuing any one of the other courses, may so adapt itself as to get back into harmony with its environment. In a cold region, as has been seen, a coat of fur can be acquired ; in deserts a regular ration of water can be renounced. Animals and plants perform physical adaptations to environment ; and we observe the visible results of these adjustments and classify the lower organisms upon the basis of such characteristics. But how is it in the case of man ? Certainly there has been little change worth mention in man's physique since the earliest records. The various local peoples, with their characteristic features, color, and so on, as we know them to-day, appear in Egyptian

paintings of some 3300 years ago (1380 B.C.).¹ Skulls and other human relics dug up from ancient strata might well be duplicated among men of to-day. Since man was man he has undoubtedly formed several races, variously distinguished on the basis of color, stature, and other minor physical differences. But the essential oneness and lack of important physical variation in man is conclusively proved by the inability of scientists to mark off genera, or even species, of men. And yet men are found under all sorts of natural conditions — conditions to which other animals have had to adapt by physical modifications of considerable degree. Man is not exempt from the penalties of non-adaptation. How is it, then, that human adaptations are effected?

139. Intellectual adaptation. There is one respect in which the various human groups in the world can be, and are in practice, set apart one from the other, and by which men of to-day can be distinguished from men of preceding centuries. This is by a comparison of what we call their *civilization*. Now civilization is a complex affair, and is usually interpreted to include institutions, morals, literature, etc., which are but remotely connected with the struggle for life. For the present purpose we wish to refer only to what may be called material civilization, that is, to those mechanic arts, instruments, systems, and the like, which have given to man an increasing "power over nature." These arts and dexterities are plainly the result of brain activities on the part both of their originators and of those who have, through generations, contributed such additions and modifications as have rendered the original inventions better suited to the situation. Now the development of this material civilization performs for man the same services which actual physical adaptation discharges for plants and animals. Instead of growing a coat of fur in a cold climate, man retains the heat of his body by making himself an artificial garment, generally stolen from the adapted animal; instead of developing feet and hands suitable for climbing, he makes ladders and resorts to a number of artificial devices; instead of extending his reach, weighting his fist, and sharpening his claws through actual physical modifications, which would take generations upon generations to develop, he artificially and briefly accomplishes the same purpose by making himself a stone or metal axe. Weaker in body, slower of foot, duller of scent and sight, than his animal competitors, he becomes superior to them all through his capacity for mentally conceiving the requirements of a situation and taking immediate advantage of them.

¹ A reproduction in color of such a painting may be seen in Ratzel's *Hist. of Mankind*, III, 162.

We say that man "takes thought" in doing all this ; and here is the key to his exceptional power of adaptation. Man does not adapt in any important measure through modifications of his hairy coat, his hands and feet, but through modifications of his brain and the secondary nervous system ; and the measure of his intellectual adaptation is what we call his material civilization, his power over nature, his industrial organization. His tool or weapon is the visible form (*realization*) of his *idea* — his conscious mental adaptation. This sets man entirely apart from the rest of the animal world. Other animals die, degenerate, flee, or attain to adaptations of physical structure ; man has done all of these things, but, as a rule, he evades them all, because of the high power of adaptation of his characteristic organ, the brain. Animals may increase in numbers up to the supporting power of their natural environment, which latter changes with no reference to their own activities ; but man, though his numbers and characters are limited ultimately by the same conditions, may, by taking thought and developing arts and processes, contrive to extract more support out of the same natural environment or may even modify the environment itself in the direction of his own interests.

140. Physical versus mental adaptation. This point deserves some emphasis and illustration, for, as we shall presently see (§§ 181, 212), trade itself is one of the artificial methods developed by man, and man alone, in his struggle for existence and comfort. Let us imagine, for example, a small island in mid-ocean, from which neither man nor beast could escape by natural means. This relieves us of migration as an element in our problem. Suppose that this island will comfortably support twenty land animals, say, dogs, and that there are just twenty there. These dogs will devour, let us say, the entire food supply, each getting enough. Suppose, now, that the numbers are suddenly increased to twenty-five ; what will be the result ? The following possibilities will be open : (1) five die and twenty live in comfort as before ; (2) twenty-five live on a lower plane of existence, i.e. have one fifth less food than before, degeneracy resulting ; (3) twenty-five live because some or all can modify — for example, can learn to get and eat sea food. This last would in time mean actual physical change, say, toward the seal or otter type. But each physical change would demand generations of time and consequently a large mortality. The death of all but the strongest twenty (the first-mentioned possibility) would be the most likely result. Thus natural selection would operate (§ 135).

Let us now make the same series of suppositions in regard to man. The first two possibilities stated above might hold with man as with animals. But instead of the third — an arduous physical modification — we should find mental adaptation, which would speedily open up new sources of support or render the old more productive ; for example, the invention of nets and hooks to catch fish, of snares or weapons to take birds or animals, of methods of treatment of soil which would render plant life more exuberant, and so on. Modifications allowing of growth of numbers, so slow in the case of animals as to call for a large preliminary mortality,

become in the case of man relatively easy and rapid; thus the first two possibilities would tend to be excluded, and the persistence of most of the twenty-five human beings, rendered possible by advance in the industrial organization, would be the most likely result.

141. "Conquest of nature." The conclusion would be, then, that man's fate lies in his own hands — or, rather, head — in very large part. This is what men have come rather generally to think — so generally, indeed, as to have become rather oblivious to the question of natural limitations and controls. It will be noted, however, that man's success in our example is due to adaptation to conditions which he cannot alter. Oftentimes his exploits do not appear to him to be adaptations, and he boasts himself in a lordly way the master of nature. The fact of it is that he has in the brain a sort of unconsciously adapting organ; he often thinks he is conquering nature when he is really discovering nature's laws and conforming to them. Man can neither create nor annihilate natural forces; under many conditions he is their plaything, but by observing their ways he can often so direct his own action in respect to them as to escape detriment or even gain profit from their action. The further course of this book is designed to illustrate both man's dependence upon natural conditions and the apparent independence he has gained through adroit adaptations originating in the brain.

However, man's inmixture into what was at one time wholly the affair of nature (§§ 134–136) does not by any means signify unquestioned and unvaried improvement. Darwin has made this perfectly clear in his comparison of artificial and natural selection.¹ Man's mental powers are limited and are not always reliable within their limits; his view-points are subject to change, and his span of life and activity is short. Too frequently, for these and other reasons set forth by Darwin with great clarity, his activity is ill-directed, inconsecutive, and, as compared with the unvarying process of nature, capricious and trifling. Ideas, or intellectual variations (§ 139), crowd upon each other, affording little opportunity for testing, until there has already followed and been attached to the reaction to be tested a series of corollaries and consequences which infinitely complicate and distract. Hence ideas and systems, while being subject to a confusing variety of interpretations, seldom meet such decisive tests as do physical variations; there is, therefore, little to withstand their persistence or their repetition, even though their effect may, at some later time and in perspective, be seen to have been unfavorable (§ 209). It is the very introduction of the human mind that brings this about; men may act logically upon their premises, but the latter are based upon what men *think* (or *feel*) the state of the case to be, rather than upon such life-and-death actualities as underlie the workings of the elemental forces of nature (§ 205). Thus social evolution is, and must continue to be, a less rigorous process than

¹ Origin of Species, Chap. IV.

natural evolution, and the survival of the fitter ideas and systems cannot be so certain as the persistence of the apter physical variation or mutation.

We are well aware that the influence assigned by us to environing conditions will, in a measure, identify us with the adherents of determinism. It seems to us, however, that whether or not we are thereby done justice, this aspect of an eternal controversy needs emphasis over its opposite. In actuality we are ready to subscribe to the following doctrine of Ratzel (Anth., II, 465): "Man's freedom from the coercive laws of nature always leaves a certain play between the conditions and the conditioned, the cause and the effect; in addition there appears a certain mutual influence of man on man, . . . which warns us not to insist upon explaining everything from one basis." Man is in reality himself a natural force like other natural forces, and is not merely acted upon as an inert thing. However, since the topic we have set before us is the influence of physical environment, that will ever occupy the foreground.

Again, the fact that so much of our material is drawn from the life of less developed peoples—the reason for this being elsewhere set forth (§ 171)—leads us to remark that we again agree with Ratzel (Anth., I, 86–88) in regarding the civilized peoples as intimately bound by natural conditions. The German geographer holds that they are even more intimately so bound, instancing the fact that civilization is certainly as dependent upon coal and iron deposits as barbarism was upon any one of its staple resources. He goes on to remark that the difference between "nature-people" and "culture-people" lies not in the degree, but in the kind, of relation in which they stand to nature. Culture is not freedom from natural control—it is a wide, broad, and complex connection (or binding) with nature. On the agricultural stage the bond is easier than on the collection stage, but both stages are naturally conditioned; the point is that in the latter stage any adverse phenomenon—for instance, the wind that makes the rice kernel fall untimely—strikes at life itself. "We are not, on the whole, more free from nature when we exploit and study her more intensively; we only make ourselves more independent of certain eventualities of her very being or of her course by multiplying our ties with her" (Ratzel, *ibid.*, 88).

We trust that the latter part of this volume, dealing with modern conditions, will, in its *ensemble*, and in many of its more special cases, justify the positions taken in the immediately following pages, and will show these modern conditions of trade to be in essence no more than complicated cases of the simpler reactions of less developed man upon a more primitive natural environment.

THE ENVIRONMENTAL INFLUENCES (LIFE CONDITIONS)

As a general proposition it is not hard to see that the destiny of the human animal and the type of struggle which he has to make in order to live, and to live satisfactorily, will differ according to the type of natural conditions by which he is surrounded. In practice it is of course impossible to take the various conditions—climate, topography, etc.—by themselves, for they occur together, and so mutually multiply or cancel their effects, or are derived one from the other in complex ways. For instance, climate and abundance or scarcity of trees

go together as cause and effect, although a distinct influence upon man's life may be assigned, by itself, to either climate or luxuriance of vegetation. But for the sake of clearness they may be separated in thought, and their effects in molding man's life considered apart from one another.

CLIMATE

142. Climate, it should be noted, is a condition over which man has no control, and can have none unless he can acquire a far more extensive power over the sun than had Joshua of old. That he can produce certain very localized "climates," e.g. in his furnace-heated houses and in his refrigerating plants of various kinds, does not, of course, affect the general question (§ 145). Consequently, man's need of adaptation to climate is a very obvious one. Let us first consider the effects of climatic conditions on man's bodily organism. Climate means, roughly, heat and cold, moisture and dryness, in their different combinations (§§ 109 ff.). The effects of heat on the organism are debilitating but not immediately harmful. By way of experiment, men have endured for short periods dry heat of great elevation; they cannot support for any considerable period, however, a temperature above that of the blood (98.6°). The oppressiveness of heat is greatly accentuated if it is accompanied by moisture; the condition of the endurance of the high temperatures just referred to was that the air should be perfectly dry, for with the entrance of moisture the limit of endurance sank rapidly. If the bodily temperature of any warm-blooded animal is raised for any extent of time (e.g. in fever) a few degrees above normal, an organic disturbance takes place which results in the rapid breaking down or non-restoration of tissues, and, in the long run, in insensibility and death. The direct action of cold upon the body is, in some ways, not dissimilar to that of heat; it results in debilitation, first of all, and it, too, is accentuated in its action by the presence of humidity in the air. Its immediate effects are anæmia and congestions of the vital organs, extreme exposure resulting in gangrene of the extremities from which the blood has been forced by contraction of the capillaries. The reduction of bodily temperature below normal results in torpor, a slowing-up of vital processes, and, finally, in death.

Dealing as we are in points of view, the designations employed respecting, for example, climate will be of the most comprehensive nature. In general, we shall distinguish merely the temperate and the tropical, with some reference to the polar (§§ 122 ff.). But it will be understood, as a matter of course, that minor climatic

gradations of all kinds are recognized as determining intermediary forms of human adaptation or activity. Furthermore, the reader will not be led to confuse our terms respecting climate by taking them to refer simply to districts formally marked off by parallels of latitude, e.g. the tropics of Cancer and Capricorn. Strictly speaking, our reference would always be to the isothermal lines (§§ 111, 118); but because areas included by these can easily be understood under the commoner terms "tropical" and "temperate" zones, the latter are deemed to be both comprehensive and, at the same time, sufficiently explicit.

143. Adaptation to climate. Now there are few places on earth where man is called upon to endure a prolonged heat greater than that of his body (§§ 117-119), and, in consequence of this, there are practically no districts left unpeopled because of direct effects of heat upon the organism. It is different in the case of cold. There are very many regions where man, as we know him, could not exist in the absence of artificial protection of some sort. It is in all ways probable, therefore, that man as an animal is a native of warm regions, and has been able to exist in colder climates only by reason of his power of artificial adaptation. By this it is not meant to assert that man has performed no physical adaptation to climate. In fact, from very early times it has been believed that several racial characters, notably color, are to be referred directly to climatic conditions. The ancients thought that the dark races were "burned black" by the sun; and it is a very significant fact that the equator is bordered, except in America,¹ by the dark races of the earth. It is certain that the great activity, among inhabitants of tropical lands, of the liver, bowels, and skin, as compared with the lungs, is a case of adaptation; it is by some closely connected with the color of the skin. Similarly, in colder climates, lighter color and a superior lung activity are well marked. The fact, that inhabitants of cold climates are wont to suffer from liver and intestinal disease and those of the tropics from lung difficulties, when they exchange environments, throws light upon mutual adaptation and non-adaptation. It may be said, broadly speaking, that races are suited to their own climates and unsuited to those of a very different type; that is, that races are physically adapted to their natural climatic environments.

Furthermore, human beings have, like animals, certain instincts which represent adjustment to climate; these lead the natives of the tropics, for example, to avoid the extremes of heat by regular cessation of exposure and of effort during the hottest hours. They suffer

¹ The absence of such color gradation in America is taken by some as evidence of the comparatively recent spread of man to the New World.

but little from heat stroke and maintain with ease an equilibrium of bodily temperature. The whole machinery of life is slowed down by these several instincts. In cold climates something similar takes place; the winter is a dormant period of carefully husbanded physical strength. In both cases the times of severest extremes of temperature are largely passed in sleep or in states approaching sleep. It can scarcely be said that this is done deliberately or as a result of reasoning; sleep is taken because the condition of the body induces drowsiness—we prefer to treat it as the action of an instinct, like that of the eel, the tiger, or the bear. The examples which have been given, then, are to illustrate man's unconscious, unpremeditated, physical adaptation to climate. This, of course, has required many centuries of time to bring about.

Several of the preceding considerations demand a word of explanation. Though all the details of the matter are not understood, it is believed that many of the physical differences between the races of the tropics and those of the temperate zones take their origin in the relative activity in the two regions of the lungs and of the intestines, the latter including the liver, kidneys, and spleen. The scavenging agencies of the body are the lungs, skin, and the organs just mentioned. It appears that the moist heat of the tropics operates to throw the burden of excretion upon the skin and intestines, while the cooler air of a more temperate region tends to develop this function in the lungs. The superior activity of the lungs seems to be connected with the lighter color of skin, while the truly tropical race, the negro, combines with a larger activity of abdominal organs and skin the larger amount of pigmentation in the latter. If, now, the white man settles in the tropics, his first manifestations of illness are generally located in the abdominal region, chiefly in the liver, and are likely to develop into hepatitis, dysentery, or similar dangerous forms. On the other hand, men and animals brought from the tropics to the cooler regions generally suffer from pulmonary trouble; to take a parallel from the animal world, consumption is usually the cause of the death of the larger apes acquired by our zoölogical gardens. These facts all go to show that the human organism has become adapted to its native environment to such an extent as to be unable to function properly in one much different.

It is supposed that the reader is now able to explain to himself the acquisition of such adaptation as a result of natural selection (§§ 133–136). But lest the predisposition to think of man as different from the plant and animal enter to disturb the thought, the following indication of the process of acquiring the "instincts" mentioned in § 143 is introduced. By *variation* different individuals and groups will develop, say, a stronger or weaker tendency to rest during the heat of the day. Those whose organisms are healthily sensitive to external conditions will feel the strain placed upon them; and if they yield to such necessity, they will preserve their strength and so prevail, in one way or another, over those who do not. The former will hand down the variation they exhibit to greater numbers of offspring than will the latter; it will tend to become fixed by *heredity*. *Selection* continuing in succeeding generations will, through its process of elimination,

reduce those presenting unfavorable variations until the whole group or race is characterized by the instinct to husband bodily energy through seeking darkness and rest in the heat of the day. That an instinct of this kind is later rationalized, so that it looks like the result of reflection and judgment, is entirely irrelevant to the matter of its origin.

144. Acclimatization. We now come to the question of man's ability to make relatively rapid physical adaptations to climate, that is, to human acclimatization. Can men, within a relatively short time, learn to live under a different climate as the natives of that climate live? It is not, of course, genuine acclimatization when the newcomers exist only by reason of their power to avoid or neutralize the climatic conditions of their adopted home. In its strictest sense acclimatization has taken place only when the immigrant can pursue the struggle for existence successfully, and propagate the race, under the life conditions of the natives. Englishmen cannot be said to be acclimatized in India when they have to be fanned, cooled with iced drinks, provided with constant rations of medicine, and when they have to retreat periodically to the hills or to the colder zones to recover their health. With some variation of a historic remark it may be said that an Englishman would not be acclimatized in India if (in order to be in the temperate zone) he had to live on top of a pillar several thousand feet high (cf. § 112). The bulk of evidence inclines to prove that there can be no genuine acclimatization of natives of cooler regions in the tropics, especially where the air is humid, except over long periods of time. Almost all the experiments which we have deal with movements from cooler northern to warmer southern regions. In these cases the factor of climate has been so controlling that northern races have been unable to preserve a continued existence and identity in the south, even when aided by all sorts of artifice and skill in neutralizing unfavorable conditions. Of movement from warmer to cooler regions we have relatively few examples. The only important one is afforded by the negroes of the United States; and even here the whole question is complicated by the crossing of whites and blacks. The population of the United States reckoned as colored has not increased, however, as fast as the white; because of the thinness of population in the United States (twenty-five per square mile), it has been subjected to little competition, especially since it tends to limit itself to the warmest parts of the country, thus securing the isolation from competition (cf. § 134) which enables it to persist. No clear case of acclimatization can be made out here. In short, if the acclimatization of men be treated as that of plants and animals

has been, the results must be the same, namely, that such radical modification takes many generations to effect. Inasmuch as generations of men follow each other at such long intervals, it would naturally take many hundreds of years to secure effects comparable with those produced in a few decades in the case of more rapidly maturing organisms. As an organic being, man could presumably come to live under any climatic conditions under which the higher animals could exist. But that he has accomplished any such acclimatization within our knowledge does not appear. Many southward migrations have taken place in history, but the migrants do not now exist. The impression is of fields of ice melting into the water of the warmer seas.

It scarcely needs to be noted that a large portion of the dangers encountered in changing from one type of climate to another are connected with exposure to new diseases. This means, in most cases, contact with a new type of organic environment — with strange microscopic "fauna" (cf. §§ 136, 150). To these the immigrant's organism is not used; and whatever native power of resistance it may possess is already debilitated by the effects of an unaccustomed climate. Where the man and the germ are both acclimatized, they have, as it were, fought it out together and sustained such mutual modifications as to render their joint presence in the environment possible. This has manifestly taken long generations, under the constant activity of natural selection. That another race, unused to all these local conditions, should be able to enter and at once successfully to cope with them is, in the light of modern science, unthinkable.

145. "Artificial" acclimatization. Having now arrived at the conclusion that man cannot become genuinely acclimatized within a practicable period, let us consider in how far he is able, through the ingenuity of his mind (§ 139), to forestall and neutralize climatic influences — to become "artificially" acclimatized. In practice this question means, Can the white race under any practical conditions live, breed, and work in a tropical climate? If it can, the "development of the tropics" and of trade therein is a simple matter; if not, the whole issue becomes complicated and arduous or impossible. There are, unquestionably, cases of protracted sojourn of individuals under the equator; and there are tropical regions in which European colonists have lived for generations, for instance, Java. Again, there are districts, like the west coast of Africa, where even a short stay constitutes a hazard to life. The mortality of the English on the Gold Coast is said to have reached six hundred and eighty per thousand. One of the most definite evidences of danger in the tropics lies in the extra premiums charged by life-insurance companies for sojourners or mere travelers in the torrid regions. The premium measures the risk of death and

is, of course, fixed as the result of a dispassionate statistical investigation. Popular opinion, derived from long series of, perhaps, forgotten instances, scents danger in the equatorial region; and it is right. In general, it is only through the exercise of the utmost caution and through the utilization of every means of artificial assistance that even a moderate settlement of whites in hot regions is possible. The dangers that threaten and the means taken to meet them may be briefly outlined as follows.

The change can scarcely be other than a violent one, and the results are presently visible in a disarrangement of the bodily equilibrium, very favorable for the reception of germs of disease to which the system is not used. The monotony of the unvaried heat (§§ 117-119) works further upon the nervous system, tempting to excesses in general and in particular to the use of stimulants. But all such irregularities are especially deadly in the tropics; what is temperance in a cooler zone becomes excess in the hotter;¹ even the abstemious Spanish and Portuguese were led to limit their consumption of their light native wines when they had settled in tropical America. At the very least, the energy of the whites is sapped and their life takes on the lethargic quality characteristic of hot regions. Again, the fact that these conditions bear especially heavily upon the women, who, in general, avoid the life of the frontier, leads to a preponderance of the male sex among the immigrants, from which results a crossing with native stocks and the production of a mixed or mongrel race. Even if this race is suited to the climate better than its white parent race, the question of acclimatization is evidently not solved, for the half-breeds might be taken to be at least semi-acclimatized at birth. And if white women do manage to endure the climate, their fertility is probably impaired; in any case childbirth entails great danger to parent and offspring, and the death rate of the children that are born is high. The natural increase of whites in the tropics is slight; natural selection, unhampered and unopposed, would destroy nearly or quite all; numbers are kept up by immigration rather than by births.

In order artificially to minimize the effects upon health of the violent change alluded to, the only practicable course is to adhere strictly to such rules as the following: avoidance of excesses of all kinds; regularity of habits, including exercise, bathing, and the like; the use of light-colored clothing, of a quantity and quality sufficient to prevent the elevation of bodily temperature or the taking of cold, the latter

¹ Care must of course be taken not to confuse the dangers of the tropical climate with those of an irregular mode of life sure to be deleterious anywhere.

being, strange to say, the great preliminary danger in hot lands ; the limitation of dwellings to healthful localities, together with strict attention to screening and sanitation ; and so on. It is, besides, necessary, especially for women and children, to plan periodic sojourns in cooler localities ; to make regular use of febrifuges and other prophylactics and medicines ; in short, it is needful, in order to maintain the life of the individual and the society, that the latest resources of modern science in the limitation of natural selection shall be drawn upon. If this is done, the individual and the race may be, to a certain degree and in a certain sense, acclimatized. A sojourn of some years may be managed at an endurable cost.

It is not so much the degree of heat that debilitates ; rather is it the endless persistence of a temperature often far exceeded by that of the temperate-zone summer (cf. §§ 117-119). Indeed, the first feeling of the sojourner in the tropics is not seldom one of pleasurable disappointment, and of delight in the perennial "summer day." But further experience wears on the nerves, and the longing for a change — for a breath of a "nipping and an eager air" — insinuates itself into the very organism of the alien. A few years more and he is invalided home to get that for which his body, as it were, cries out. In the opinion of one competent surgeon, who has lived much in the tropics, seven years represent the central European's limit of endurance of the equatorial climate, even in an island region and for a strong man. Such a man, he adds, must not be corpulent ; and he must not be subjected to great strain or deprivation.¹

But if societies of whites can manage to exist in the tropics, they cannot, even with the aids recounted, by themselves pursue successfully the struggle for existence. Labor, especially arduous and continuous labor, is inconsistent with both the physical health and the mental condition of the white man in the tropics. The vital processes will not stand the strain, and the state of the will does not supply the energy for strenuous exertion. This is especially the case in regard to the occupation by which life must be assured — agriculture. The disturbance of tropical soils exposes the laborer to the action of various germs from which he is relatively protected if he refrains from labor. But to make anything of the tropics, labor of the most arduous variety and in the greatest quantity must be put forth ; for while it may not be a necessary condition, it is none the less a historical fact that the characteristic tropical products which have been profitable in the world market — cotton, sugar, coffee — cannot be raised on the small

¹ Hagen, *Unter den Papua's* (Wiesbaden, 1899), p. 20.

scale. Owing to these conditions, the white race has never been able to support itself by its own efforts in the hot countries; the aid of an acclimatized labor force is the only staff upon which it can depend. As for the use of machinery, it cannot be profitably employed in small-scale production; while in operations on the large scale the very employment of the machines calls for heavy labor. The conclusion seems therefore justified, that Europeans, even with the aids of science, are unable at present to make themselves at home in the tropics. Natives of cooler zones live in the tropics, usually temporarily, as directors or superintendents of an inefficient labor supply. It would follow that the riches of the tropical lands have never been developed or even utilized to any great degree. It is said that the valley of the Magdalena River alone could feed fifty millions of people, whereas the population of all Colombia is but four millions.¹

A comparison may bring preceding contentions more clearly to view. The great colonies of acclimatized whites are Canada, the United States, part of Mexico, Argentina, Chile, southern Brazil and its environs, Cape Colony, Australia, New Zealand, southern Siberia; all these are in the temperate or subtemperate zones. The number of whites per square mile in the tropical zone may be judged from the following examples assembled almost hit-or-miss (as criteria of comparison there might be taken the United States, with some 25 per square mile, and the United Kingdom, with some 345): Hawaii, 4.4; Algeria, 4; Brazil, 2; Cochin China, .4; Ceylon, .38; Philippines, .2; British Guiana, .18; Dutch East Indies, .1; Sierra Leone, .1; Tongking, .08; Madagascar, .07; British India, .06; Eritrea, .04; Nicaragua, .025; British East Africa Protectorate, .01; Southern Nigeria Protectorate, .01; Colony of Southern Nigeria, .01; Cambodia, .01; Togoland, .008; German East Africa, .006; Anam, .005; Kamerun, .005; Congo Free State, .003; French Ivory Coast, .0025; German New Guinea, .002.

It may be repeated that these figures do not, in most cases, mean "settlers"; of the 533 whites in the Southern Nigeria Protectorate, for instance, 199 were officials and the other 334, merchants and missionaries. Again it must be realized that there are a number of the tropical colonies where it is either impossible or not worth while to "catch and count" the few wandering adventurers of European stock. It has been impossible to find out the functions of the men who constitute this slight European population, but it is certain that the majority are officers, agents, missionaries, or the like. There are very few European families.² Yet to make this comparison fair, it must be realized that the chances for adventure and gain were much greater in the tropics, especially at the outset of the Discoveries Period, and that consequently a larger initial immigration was attracted to tropical colonies, thus giving them the start over their later rivals.

146. Climate and civilization. If it is true that man has been for an indefinite period chained to his general type of climatic environment, — hot, cold, or temperate, — then, neglecting his physical

¹ Ratzel, *Anth.*, II, 266.

² The above figures are based upon those of the *Statesman's Year-Book* for 1907.

adaptations, of which we have briefly spoken, let us consider the effects of these three general types of climate upon the development of civilization, that is, of the apparatus of artificial adaptation. This really means, as we have seen (§§ 139, 140) the effects upon the development of mind and mental reactions. The first general fact, with which we are confronted is that no great civilization has ever taken origin within the torrid regions of the earth. The seats of ancient culture—the valleys of the Chinese rivers, of the Euphrates and Tigris, of the Nile—are all within the temperate or subtemperate zone.¹ The Aztecs and Peruvians, the two most advanced peoples of the Americas, occupied highlands where altitude tempered latitude. It is true that India boasts an ancient civilization in a region at least partly tropical, but it was not self-sufficient or self-propagating; the vigor which it displayed was lent to it by periodic reënforcement of fresh blood and vitality from the cooler regions. The same thing may be asserted regarding those other seats of ancient civilization just mentioned, even when they lay farther from the equator; the development of civilization generally took place in the warmer parts of the temperate zone, but those who developed it came for the most part from the north. This was so at the outset, and the situation has not changed through history. In our own day the nations of the temperate regions of the earth still represent civilization, while the hot or cold zones form a field of activity for the overflow of their energy. In the north temperate zone are Europe, southern Siberia, China and Japan, Canada, the United States, and the center of activity of Mexico; in the south temperate, southern Brazil, parts of Peru, Argentina and Chile, Cape Colony, Australia, Tasmania, and New Zealand. It is significant that the movement for independence of the Spanish American states grew to strength in Argentina, and that for Brazilian independence in the southern region of São Paulo; in these cooler districts lay the numbers and the energy.²

147. Extra-temperate conditions. These striking and significant considerations certainly have a physical explanation behind them. It would be hazardous, of course, to refer them to any single cause, such as the difference of temperature. But taking together the influences of climate and the complex of physical factors which vary with

¹ "For the earliest development of civilization . . . the warmer climate—as the one making less demand—has wielded a more favorable influence" (Ratzel, *Anth.*, I, 332).

² Keller, *Colonization*, pp. 159 ff., 321 ff. "Even in densely populated India and China the largest areas of density lie, in the one case, north of the tropic, and, in the other, of the parallel of 30° north latitude" (Ratzel, *Anth.*, II, 267).

climate, — abundance of vegetal and animal life, etc., — we may distinguish marked effects upon the numbers and character of races referable to residence within cold, hot, or temperate regions (cf. §§ 122 ff.). In the colder regions the struggle for existence presses constantly upon the individual and the society; the most strenuous of activity yields little more than enough to satisfy immediate needs. The winning of subsistence demands almost the total of bodily energy. The astonishing cleverness of invention to which men are driven enables them to continue to live rather than to rise to a higher plane of comfort; little energy is freed for what we call higher activities, i.e. more perfect and successful adaptation. Numbers are restricted by the possibilities of the region, the death rate being high and the birth rate low; any extensive disturbance in the food-yield of the environment results in great mortality; the polar peoples live on the edge of things and are readily pushed over the brink. Their numbers being small and scattered, — the total Eskimo population of North America is estimated at about 25,000, and they live in segregated groups of at most a few families, — the development of culture through the contact and reactions of individuals and groups is impossible.

The importance for the growth of civilization of numbers and their contact will be taken into account in a later chapter (§§ 166, 173); but it is to be noted that for the polar and some subpolar regions the sparsity of population, rendered inevitable by climatic conditions, precludes all serious advance of culture. The following estimates are made of the density of population per square mile under such conditions: Hyperboreans (of northern Asia), 2–25; Kamtchadales and western Eskimo, less than 1; Indians in the United States (1825), 0.57 (Peschel); Eskimo of Greenland and Labrador, 0.24 and 0.3 respectively; Aleuts, 0.3–1; natives of Alaska, 0.5; Reindeer Chukchi, 0.4; Patagonians, less than 0.1. In addition it may be said that north of the wheat zone there are very seldom over 40 to the square mile, beyond the barley zone almost never over 2, even in Europe.¹

In the hot lands, on the other hand, the struggle for existence is often the opposite of arduous. The luxuriance of nature is such that the indolence engendered by the elevation of temperature is fostered rather than assailed by the vicissitudes of life. In several tropical lands, under natural conditions, twenty-seven breadfruit trees, covering an acre, are said to suffice, at the expense of a few days' labor, to support a family of ten or twelve for the eight months of bearing. A great deal of fruit can be had simply for the gathering, and when one

¹ Ratzel, *Anth.*, II, 256 ff., 205.

kind is giving out another is attaining maturity. In ancient times the date palm is said already to have had 360 uses (Strabo). It would not be difficult to collect many instances of the easy life of the tropics ; most accounts of travel in these regions teem with them. Captain Cook reported that a Polynesian who had in his lifetime planted only ten breadfruit trees had done his duty to his own and the next generation as fully and richly as some farmer in a colder climate who had plowed and harvested in raw and inclement weather his whole life through, and finally saved a meager sum for his children. The changelessness of the seasons relieves man from the taking of thought for the morrow ; he lives the life of the day and develops but a rudimentary foresight. Breadfruit introduced from the Pacific is said to have carried the Caribs back to savagery (cf. §§ 175 ff.). Other natural needs than those of food, e.g. clothing, are few and easily satisfied. The spur of necessity is absent ; as life is, as it were, too hard in the cold regions, so it is too easy in the hot. That in nature which really calls civilization into being and then secures its advance is not the prodigality of gifts offered to man, but the incitement to effort of which he is the (often resisting) object.

148. Temperate conditions. Between these two extremes a kind of life is lived where effort and reward are more equitably adjusted (cf. §§ 116 ff.). In the temperate zone, life is scarcely possible without sustained effort ; but the rewards of labor are generous, returning not only subsistence but a surplus.¹ Effort is not harmful to health ; in fact, the well-being of the body calls for it. Temperature and light conditions are favorable to industry. The length of the working day is at a maximum ; it is said, for example, that "the climate of the British Isles enables men to work in the open air for more hours a day throughout the whole year than in any other part of the world." The changefulness of the seasons demands facility of physical adaptation, a mobility of the organism, and also a development of economy and foresight to provide against times of scarcity. The contest with nature is enlivened by the elation of well-planned and well-won success.² Numbers increase rapidly and, in contrast with the generally sluggish inertia of hot countries, societies move about, mingle, and naturally give and receive the civilization that each possesses. From this

¹ It has been said, with the exaggeration natural to such condensation of statement, that in the cold regions man gets nothing for something, in the tropics, something for nothing, and in the temperate areas, something for something.

² This influence of climate on disposition should never be ignored ; it is shown by too many peoples in forms too nearly parallel to allow of an absence of causal connection. See Ratzel, *Anth.*, I, 314.

results a progressively increasing power of intellectual adaptation to allied varieties of shifting conditions; that is, an ever-augmenting knowledge of and power over nature. Such faculties and masteries develop even more irresistibly with increasing exercise; civilization grows by feeding upon itself; and presently there exists between the progressive groups of the temperate regions and the hampered ones of the regions of extreme cold or heat an impassable gulf, a sharp distinction, a relation of superior and inferior.

Nearly 98 per cent of the world's population live between the isothermals of 4.5° and 21° C., and almost 75 per cent between those of 7° and 15° . The greatest density is found in regions where the temperature in the warmest month is between 21° and 27° . Nearly all the great cities lie in this belt.¹

Enough has perhaps been said to establish the general proposition that human societies can be distinguished on the basis of the climate of their stations. Although this is a very broad distinction, it will be found to be of practical value for our subject; and it can be applied to relatively local cases when properly limited by reckoning in other and more special factors of environment.

¹ Ratzel, *Anth.*, II, 206.

CHAPTER VIII

ENVIRONMENTAL INFLUENCES

FLORA AND FAUNA

149. Importance of the organic environment. The next factor of environment which deserves especial treatment as of extraordinary importance to the life of man is the organic life of a lower grade—the kind of flora and fauna, the quality of plant and animal life — by which man is surrounded, with which he has to contend, or upon which he is able to prey.

This factor, as has been seen (§§ 133 ff., 144), is very closely connected with climate; for instance, the long and continuous solar heat has a very marked effect upon the quality of grain, so that fine wheat is raised at 60° N. in western Canada, and the same cereal can be ripened in Siberia in as little time as in the Nile valley. Furthermore, other natural factors, like rainfall (§ 120) and ocean currents (§ 19), influence the distribution of flora and fauna; and there enters, directly as respects flora, and indirectly as respects fauna, the controlling condition of soil (§§ 69 ff., 78). Naturally this latter influence is indirect in its impact upon the man-animal, and consequently can receive little mention in the present section of this book; but that it remains a powerful factor, though, as it were, behind the scenes, must not be lost to view.

The character of the flora and fauna of his habitat can seldom be regarded as a matter of indifference to man. The whole of physical nature is so bound up together that whether the bonds of relationship are open and obvious, or hidden and subtle, there are yet but few parts of the whole that are not sensitive to the fate or form or movements of other parts. In the case of man his plant and animal environment is often determinative of his existence and its vicissitudes; the humbler forms of life may be man's ineradicable enemies, his prey, or his friends; they are seldom neutral and must always be reckoned with in a greater or less degree.

150. Man's enemies. For example, let us take the influence of the flora of a country upon its human inhabitants. Naturally enough plants can scarcely be hostile to men in the way in which active, moving beings could. However, there are cases which approximate to direct competition; for instance, the exuberance of tropical vegetation is such that it is constantly encroaching upon artificial clearings and

can be held at bay only by constant effort ; practical experience with this phenomenon has been gained by those who are digging the Panama Canal. Life in deep forests is passed in a sort of gloom ; for the thickly interlacing branches of trees and the strands of creepers practically monopolize the sunlight to the detriment of terrestrial beings ; the impenetrable " scrub " of Australia occupies the surface of the earth to man's almost total exclusion. No human races of any importance live in areas of such competition. It might also be said that poisonous vegetation is hostile to man ; on the whole, however, there is no significant and well-recognized danger from plant sources. But in the case of fauna the relationship of hostility is, especially at the outset, strikingly marked. In fact, if we can realize the condition of man before the invention of tools and weapons, we can see that he was, like other animals, through his very struggle for life, at swords' points with his fellows (§ 134). In much later times he is still in relations of hostility with many groups of animals. The presence of large carnivores is in some places a constant danger ; in India, in 1904, though the records are not full, some 25,000 human beings and 100,000 cattle were reported killed by wild beasts. In Russia, in 1875, wolves are reported to have killed 160 persons and to have destroyed animals (cattle, sheep, dogs, etc.) to the number of over 1,340,000. The cost of their depredations, not counting the game which they killed, is estimated at \$24,000,000 per annum for the Empire.¹ Venomous creatures of all kinds — scorpions, serpents, insects, and so on — exist in many lands as hostile elements that cannot be tamed. Of the above-mentioned deaths in India about 22,000 persons perished by snake bite, and the remainder were prey of panthers, tigers, etc. ; of the cattle about 86,000 were killed : by panthers, 40,000 ; by tigers, 30,000 ; by snakes, 16,000. The sting of the *tsetse* fly has proved fatal to cattle in central Africa, and an allied insect is now thought to be the cause of the " sleeping sickness " found among the negroes of the same region, but hitherto unexplained.

Consider for a moment the wide-reaching effects upon man produced by the presence of this small gray fly in the environment. Aside from any direct effect upon human health, this influence has meant the retardation of native progress, inasmuch as the use of the best domestic animals has been impossible ; thus a well-marked stage of advance in the industrial organization, with all that that meant for the development of more effective social structure, has been unattainable. The more recent embarrassments in the building of railroads and the like in the absence of beasts of burden and draught are self-evident. Unquestionably, the presence of this insect, rendering impossible the use of draught animals, has

¹ Bourdeau, *Monde Animal*, p. 115.

kept men in the status of beasts of burden, that is, it has called for the persistence of slavery. The Boers, depending upon draught cattle, could not penetrate northward beyond the twentieth degree of latitude; and it is now proposed, in the hopelessness of the task of exterminating the fly, to remove all the surviving negro population of the most infested districts.

Further, parasites live upon and within the human body, causing irritation, sickness, and death; and if we descend to the microscopic fauna, the living germs of disease, the menace to human life in certain localities (§ 144) becomes definitely apparent; fear of the larger beasts is often exaggerated; but that of the minute ones is seldom proportionate to the menace which their presence signifies. On the west coast of Africa even the natives have malaria; yellow fever infests the tropical Atlantic coasts; the plague, leprosy, beriberi, and other diseases decimate the inhabitants of this or that area. The scourge of the world is tuberculosis; in this country the deaths from the disease average nearly 25 per hour. Yellow fever in the past 115 years has caused fewer deaths in the United States than did tuberculosis in the year 1907; from 1903 to 1907 this disease "caused more than three times as many deaths in this country as occurred in action and from wounds received in action during the entire Civil War."¹ The influence of the presence of hostile fauna is in many cases determinative of the life of man and society; and since in a general way the habitat of these enemies is determined by climatic conditions, their activity is really added to that of the climatic factors already noted.

It would be possible to introduce at this point a considerable amount of matter that goes under the name "geography of disease," or some similar term. In any work dealing with man's relation to his environment, and having no special activity of man in view, it would scarcely be permissible to curtail such a topic. For the present purpose, however, we shall devote no further direct attention to the matter; for however important to man's life in general the distribution of the microscopic fauna may be, as a factor in the life of his trade it can so easily be included in the treatment of the climatic factor and others,—and has been so included, at least by implication, in foregoing and subsequent paragraphs,—that it seems unnecessary to assign it a special space. This is one of the topics which may well be left to the teacher. The superposition of the ordinary trade areas and routes upon a chart showing the several important disease areas will tell its own story (cf. fig. 21). The grandest processes, of course, in which disease geography bears a conspicuous part, and one directly effective upon commercial development, are those treated above, under the topic of acclimatization (§ 144).

¹ The Metropolitan Life Insurance Company of New York has recently (1909) issued a pamphlet for the use of its policy holders, entitled *A War upon Consumption*. It contains graphic illustrations and striking facts. That insurance companies are trying to lower the mortality of their risks through such educative measures is significant.

151. Man's prey. Man is not exposed in helplessness, however, to the inroads of such competition. It is probable that races have in the course of time acquired a certain immunity—which amounts to a race character—from disease localized in their habitats. This is due, of course, to natural selection (§ 135). To Europeans measles, influenza, and even scarlatina and smallpox have lost their terrors in comparison with, say, tropical fevers; they are to a certain degree inoculated against the former because of the long experience of their ancestors with them; the negro, on the other hand, is practically immune from yellow fever, but is susceptible to diseases of the lungs. Civilized peoples in general, aside from their control of medicines, are proof against more diseases (which are largely a product of the very concentration of population which fathered civilization) than are natives. Colds, influenza, and measles carried the American Indians off by thousands; phthisis destroyed whole groups of Polynesian islanders. The whites possess greater resistive power against disease because, as a race, they have suffered from it longer and have been modified toward resistance. There is, therefore, such a thing as an inherited immunity from the attacks of the virulent microorganisms.

But man is not content with such slow-working natural means; he turns into the struggle his power of intellectual adaptation (§ 139), and not infrequently emerges as victor, where without his power of reason and invention he could not have prevailed. It is hardly necessary to refer to such action in respect to the plant world. The clearing of the forest through burning and cutting, the extirpation of such vegetable life as interferes with man's purposes, is pursued, within certain limits, with absolute success (cf. §§ 83, 156). The same kind of irresistible attack is made upon animal life, which, under conditions prevailing in nature, would compete disastrously with the human race. For example, man is physically inferior to the panther: weaker, slower of movement, duller of sight and scent, with paw less heavy and claws less sharp and rigid, he enters the lists without hope except for his intellect. By the aid of the latter, however, he has made him a stone or metal ax. His reach is now longer, his blow stronger, his artificial fist harder, his stone claws as sharp and more unyielding than those of his adversary. He prevails in the struggle; and, as the fitter, he survives. When he has attained to the express rifle, the contest is decided once for all; wild beasts that were a terror to early man are constantly yielding ground as the prey of modern firearms;¹ whole

¹ In India in 1904 there were killed 1285 tigers, 4370 panthers and leopards, 2000 bears, and 2086 wolves. Of the serpents, the greatest scourge, relatively few

sections of civilized countries are without dangerous wild animals or reptiles. And the war carried on against these larger fauna is not to be compared in strenuousness with that directed against the germs of disease. The development of the medical and sanitary arts represents in good part the systematic character of this pursuit (§ 96). The germs of disease are ferreted out, experimented upon, and actually bred and altered; antidotes and antitoxins are developed which will kill them or alter an environment for their disadvantage. Through vaccination smallpox is rendered relatively harmless, and fevers are met with strong febrifuges. By drainage or the use of films of oil on ponds and marshes the germs of malaria, together with their transporter, the mosquito (*anopheles*), are swept in a body out of the local environment. It should not be forgotten, moreover, that man is constantly waging war against disease in behalf of his domesticated animals. In all these cases and many more which will occur to the reader, man, by his special power of intellectual adaptation to situations, renders many varieties of flora and fauna his prey.

152. Man's food supply. But man can do more than this. As an animal he supplies the waste of his body almost wholly from the plant and animal world. Hence, to get food he wages an offensive as well as a defensive warfare on nature; and he has even carried on a cannibalistic strife, it must be added, with his fellow-man. Hunting, in a general sense, was the occupation which yielded to our remote ancestors the whole of their sustenance; wherever possible, vanquished competitors, plant, animal, and man, have been turned to food. To gain the upper hand not only the force of dangerous animals but likewise the wile of the weak has been rendered of less avail by the mental activity of the man-animal that had "brains"; weapons, traps, hunting and fishing devices — all were artificial means of neutralizing the advantages of power, swiftness, cleverness, and the like on the part of animals, or of taking advantage of their stupidity, curiosity, special instincts, or other characteristics. The driving force behind all these activities of offense is hunger, this term being taken to cover all kinds of physical need whose satisfaction means maintenance of vitality.

The character of the food thus derived by man from nature has exercised a very important influence upon his life; the flora and fauna were killed. The cobra, which is alone responsible for some 20,000 deaths yearly, is sacred and the natives will not harm it. A similar superstition protects crocodiles, sharks, etc., in several localities. However, it is reported that there were destroyed in India in 1881 and 1882 no less than 575,000 serpents, and in 1906, 762,221. Cf. W. G. Fitzgerald, in the *Technical World Magazine* for May, 1907, pp. 311 ff.

of his environment, together with certain mineral and other elements, have come ultimately to constitute his own body. Different combinations of these elements have met in differing degree the demands of the human organism. What these demands are, and in how far various foods suffice to supply them, we shall presently endeavor to show.

The body of man, as of the lower organisms, is to be conceived of as a great mass of living cells, which die and are replaced during every hour of life. Every action and thought, voluntary and involuntary, is realized at the expense of the death and removal of a part of the bodily tissue. Non-replacement of such losses would mean speedy dissolution. But the replacement comes through the nutritive substances introduced into the body. Hence, in a certain sense, a man is what he eats. The getting of food must thus be the first and most necessary activity of any organism, and the animal is driven to this activity by one of the most elemental passions, the sensation of hunger, which impels to the repairing of the waste whose existence calls it forth. Thus the prime interest, the *conditio sine qua non*, of man's as of the animal's life is the appropriation out of nature of what will restore his body and its forces. This fact is perfectly self-evident, yet, in some of its bearings at least, is often lost sight of. Further, the scope and variety of bodily activity must bear relation to the quantity and quality of food used in restoration of waste. Only the dormant animal can go without food; and where the winter food supply is meager we find even human life approaching that of the eel and bear. Those peoples, on the other hand, whose food is sufficient in quantity and quality exhibit the most varied and productive phases of human activity.

153. Food and climate. The chemical elements necessary to repair the constant waste of the body are, in general, proteids (the typical constituent of lean meat, albumen, etc.), carbohydrates (found in fresh green vegetables), and fats. It is almost a commonplace fact that food varies with climate: in the arctic region, where heat is at a premium of importance, the diet is almost exclusively meat and fat; blubber is devoured in great quantities, and the ravenous eating of tallow candles and even soap by Eskimo children is well attested. Again, the food of the tropics is largely vegetal: manioc, bananas, sago, yams, etc. In the temperate zone the diet is mixed, but has always included a large amount of proteid in the form of meat, excepting where conditions of poverty in a well-occupied country forbade. Naturally, as has been said, the food will be, in the last analysis, what the flora and fauna provide; but the above tendencies toward preference are strongly marked. It is a fact, of course, that in several areas of teeming population, especially toward the south, vegetal food supplies up to 99 per cent of the entire nourishment. Millet in Africa, rice in Asia, bread-fruit, sago, dates, etc., are the great local *pièces de résistance*. And

specialization in the case of rice, at least, goes so far that rice-eaters either reject, or have been found not to thrive upon an unaccustomed even though vegetal, diet; those colonies which employed coolie labor were obliged to import rice to feed the coolies. The heavy population of such vegetarian areas tends so to weight the general average as to lend strength to the view that man is naturally a vegetarian — a conviction which is not fortified by the results of the study of morphology. It should be added that the body requires certain amounts of inorganic substances, as, for instance, lime and salt. Ethnography and legend afford us but few instances of peoples that did not use salt; and where it was not used it is either certain or highly probable that less satisfactory substitutes were employed. Together with reindeer, horses, and other animals, man seems to have a very pronounced taste for salt; indeed, in some parts of the earth it has become, as a prized and universally acceptable article, the local medium of exchange.

154. Stimulants and narcotics. While dealing with the subject of food, it is not irrelevant to attach some remarks upon the nature of several substances which are introduced into the body less for nutriment than for the sake of the sensations provoked. These are called stimulants or narcotics according as the nerve response (which is the thing desired) is quickened or temporarily deadened by them. The stimulation and the deadening are but complementary phases of the same activity of the agency in question. The simplest stimulants are the spices, — which are often no more than excitants of bodily secretions, serving thus to render a monotonous diet more appetizing, — and the most famous spice in the history of trade is pepper. It was extraordinarily popular in Europe in the Middle Ages for the reason just cited. The stronger stimulants are those which, in large quantities, would produce death; each of these contains some essential principle which is, in isolation, a poison. Such a principle is the alcohol in all fermented liquors, the cocaine of the *coca*-nut, the caffeine and theine of coffee and tea, the nicotine of tobacco. So welcome to primitive man has been the effect of these, that in all parts of the world where grain and fruits which contain starch or sugar (i.e. which would ferment) have grown, alcoholic drinks corresponding to the local product have been discovered: beer and barley; wine and the grape, or banana, or palm; saki and rice; rum and sugar-cane; pulque and the maguey, — such intoxicating beverages have gone with such flora. Naturally, then, the stimulant varies with the climate via the plant: the betel is local in the East Indies; opium was similarly restricted prior to the

development of transportation, and the Eskimo is perforce temperate until the white man comes. The greater the success of the distilling process the stronger may be the stimulant; hence, although the civilized races did not introduce the uncivilized to this form of nerve titillation, they did provide as a substitute for the native drink, weak in content of alcohol, a devouring substance aptly termed "fire water." Alcoholism is one of the diseases of civilization; the "natives" have fallen before it as they fell before smallpox and consumption. While the native stimulant was not seldom a prophylactic or medicine (e.g. the betel nut), the impure articles purveyed by the frontier traders were too often outright poison. For increasing quantities of such stimulant the nerves, awaking from torpor to feverish action, unceasingly call. Even in the case of the milder articles like tobacco (§ 232), the demand is ever on the increase; hence the tremendous importance of this class of plant products to man and, of course, to trade. The fact that several of the historically most important of the above products were by nature so capriciously and strictly localized (e.g. cloves in the Moluccas) has lent a peculiar character to trade in them (cf. § 197).

155. Fuel, clothing, and shelter. Requisition may be made upon nature not only for food to repair the waste of the body, but for that which will, by affording protection from the elements, minimize this waste; looked at in one sense, fuel and clothing replace food by economizing the expenditure of bodily heat. The Indians' theory of the coming of the European was that wood had given out in the white man's country, and he was moving on after a better supply. That the need for and the character of fuel vary in different regions is well known. Clothing is in good part a matter of climate and varies from the thick furs of the arctic to the thin and scanty fabrics of the tropics; from the garment of the cold zones, fitted tightly to the body, to the loose and flowing draperies of the warm countries, which are less "clothes" than "cloths." Clothing, of course, varies also with the animal and vegetal stuffs available for the purpose: in the cold regions only animal products are at hand; in the Pacific islands the natives have used the inner bark of the palm (§ 229) to make fabrics (tapa cloth); in Peru, the hair of the alpaca; elsewhere, grass, paper, the fleece or wool of sheep, and so on. Many and curious instances could be multiplied. A further protection for the body is the dwelling, which discharges the function of clothes, on the larger scale. The same dependence upon flora and fauna appears. Building materials vary and the local form determines the type of house: bamboo is utilized wherever it grows; palm leaves, reeds, or grasses furnish thatch;

dwellings are made of leather and felt where cattle are raised ; and to these may be added — though they do not come under the topic of flora and fauna — snow and ice in the polar regions, adobe in the deserts, and stone¹ in many places. The presence of weathered or eroded rock, forming caves, which need little or no alteration in order to become inhabitable, has determined the type of dwelling in many localities. It is plain that, apart from the last few examples, introduced here for the sake of convenience, the type of clothing and dwellings varies with the nature of the local flora and fauna, as well as with the climate which conditions the life of both animal and man.

It might be pointed out as a further but perhaps less obvious influence of environment, that the whole plan of the dwelling in warm climates differs from that of colder regions. Contrast the early Greek style of house, as preserved in the temples, etc., with that of, say, Scandinavia. The former is open, pillared, windowless ; the latter closed against the weather, chimneyed, with windows, packed with smaller compartments, and so on. Like northern clothes, as against southern "cloths," it "fits tight." Gradually such differences became a matter of pride and distinction, so that the Greeks regarded as barbarians those tribes that ate butter instead of olive oil, drank beer instead of wine, wore breeches instead of flowing robes, and so on. Depreciation of other peoples because of their characteristic ways, habits, etc., derivable from adaptation to their stations, is a rather constant phenomenon up to and including the present day.

156. Miscellaneous instances. The vital importance of the plant and animal environment should now be clear. And it would not be difficult to assemble a number of cases where the presence or absence of certain forms of flora or fauna, generally, of course, in conjunction with other factors, has determined the whole history of a society. The Northwest Indians of Canada, it is said, used cedar for everything ; the Arabs built their lives on the date palm. Take, for example, the presence of wood suitable for the building of ships, as a factor in the production of a maritime power (§ 194) ; that of spices in the Moluccas, leading to their ruthless exploitation ; the "curse of rubber" in central Africa. When iron ore was smelted solely by the use of charcoal, Sweden's forests made her one of the chief iron-producing nations. The growth of the science of forestry (§ 231) is an indication of a tardy realization of the importance of this flora.

Deforestation represents a case of success in the struggle of man against nature too great for man's own good ; he demonstrates his power to the exclusion of his foresight (§§ 80, 83). By such actions "there is always removed from between

¹ It may be noted, as a local instance of the conformity of dwelling to environment, that stone buildings have had to be avoided in regions of earthquake, for instance, in the Philippines.

him and the destructive nature-forces an important intermediary factor."¹ He sacrifices the weal of future generations to the accomplishment of shortsighted purposes; he destroys the value of the soil and of the rivers, causing the latter to carry their water not in a steady stream but in destructive floods (§ 231). Thus deforestation and growth of civilization have gone together, though the former is bound ultimately to injure the latter. The older culture-lands are regularly poorer in forests; several years ago Europe was 18 per cent forest land, but this was divided in the following significant ratios: England, 4, Germany, 26, Russia, 37, Sweden, 39 per cent. North America, and especially the United States, have suffered rapid deforestation; even before 1880 the rate was 2 to 3 per cent yearly in Ohio. The New England states have suffered in the loss of their forests (§ 230); even Maine is less than 45 per cent forested.²

A similar importance may be assigned to fauna. The Indians of the prairies lived and passed away with the game (chiefly bison) upon which they preyed. The introduction of the horse molded their whole type of life. The seal and other aquatic booty render the existence of man possible in arctic America, the reindeer in northern Asia. With the decline of traditional food supply, the Eskimo of Alaska are being rescued by the introduction of the Siberian reindeer. Still another curse, that of ivory, has rested long on equatorial Asia. Instances might be multiplied to demonstrate the great influence upon man's life of the plants and animals among which he lives.

This fact of the intimate relation of man to the lower organic life is a commonplace to primitive peoples, for they are constantly obliged to recognize it in their daily life. Their attitude toward the animals, naturally enough, is one of respect, as for redoubtable rivals in the struggle for existence. Not infrequently they imitate these competitors and even conceive themselves to be derived from animal ancestry. This is to them a matter of pride. Such a sense of solidarity with the rest of creation has been lost by civilized man, or the relationship (as in the case of the microorganisms) has come to be looked at from a totally different point of view. Ethnographical writings are loaded with instances of the recognized close relations of men and animals. The ones given in foregoing connections are selected more or less at random but as bearing ultimately upon trade. It would be a profitable labor to incite the student to collect other instances from books of travel and of description of the life of savage tribes.

157. Domestication and breeding. Man is not limited, however, to merely defensive and offensive operations against flora and fauna. He is able to seize upon certain hitherto hostile or neutral elements of opposing nature, drag them, as it were, across the battle line, and actually force them to fight, as friends and helpers, upon his side in the struggle for existence. That is, he may domesticate both plants and animals; fashion them toward his purposes as affording supplies

¹ Ratzel, *Anth.*, II, 248.

² *Ibid.*, pp. 123 ff.

of food or clothing ; or even, in the case of animals, cause them to put forth physical energy in the realization of his own purposes. This topic deserves considerable attention, for it illustrates with especial force man's peculiar capacity over other animals in adaptation to situations. Certain other creatures, notably the ants, display an instinct which leads them to dominate or even domesticate fellow-insects ; but man is alone in the rational practice of breeding subjected animals in confinement.

To illustrate the aid and comfort afforded to man by domesticated animals is scarcely necessary ; each lends to man's purposes his special superiorities of strength, speed, sharpness of the senses, and the like, besides providing him with food and clothing. It is probable that most domesticated animals were originally designed for food, but later man appropriated their other qualities. If a huntsman has a good dog he has practically appropriated his speed, sense of smell, etc., and need not develop these qualities for himself. The most anciently domesticated or most closely attached develop under selection the very instinct of service, together with acquired skill in performing it ; the dog is the best example of this class.

But the extent of man's utilization of flora and fauna, as the last example indicates, is much wider than mere appropriation ; he does not stop with the forms given him in nature, but proceeds to modify these in the direction of his own needs or desires. When his domestic plants or animals began to propagate, it did not take man long to perceive the action of heredity (§ 135), nor to conceive the possibility of controlling, by careful mating, the character of the offspring. By selecting the forms which appealed to him, and breeding from them alone, he managed gradually to "improve" his domesticated flora and fauna ; this process, going on through ages, has resulted in the production of plant and animal forms much more satisfactorily adapted to the wishes and purposes of man than are those occurring in nature (cf. §§ 214, 236). The kernels of grains have been increased in size over those of the grasses from which they came ; vegetables have been similarly modified and rendered more palatable ; fruits have been selected for size, color and flavor, presence or absence of seeds, and so on. The labors of Luther Burbank along these lines, and his results, if correctly reported, constitute probably the most striking example of plant breeding in history. A progressive bureau of the United States Agricultural Department has accomplished marvels along similar lines (cf. § 214). There are ways of turning the development of plants in this or that direction, i.e. by modifying environmental conditions and

selecting for size of root, quality of seed or fiber, and so on. Flax in the United States is raised largely for the seed, because American producers are not willing to put forth the intensive labor necessary to produce a fine fiber (§ 228). In short, the vegetable products of modern commerce are in very large part the direct results of the domestication of relatively useless flora, and of the modifications produced by long ages of artificial selection. This may, of course, be carried to extremes by the preservation of monstrous forms, and by sacrificing a certain balance of valuable qualities in favor of the one or two which appeal, it may be, to the fancy only; such are the "freak" productions of agricultural fairs.

158. Selection and improvement. The effects of selection are rather better known in the case of animals. It has been said of sheep breeders: "It would seem as if they had chalked out upon a wall a form perfect in itself, and then had given it existence." Thus a sheep is bred for size of body or for quality of wool, according as it is to furnish man with mutton or with clothing. The horse is bred for massiveness and strength, or for speed; or it may be bred for peculiarities of marking or for smallness of size. Cattle may be bred for meat or for leather, for milk-giving qualities, for short or long horns, and so on (§ 236). There are two hundred or more varieties of domestic pigeons which breed true; and yet it is practically certain that all these varieties run back to a common form. The many varieties of dog are thought to have been derived from a few wolflike species.

The improvement attained by such selection is a matter of common experience: compare the big-bodied, unwieldy domestic swine with the long-legged, swift, and dangerous wild boar. The cow native to South Africa yields at most three pints of poor milk per diem to strenuous exertion on the part of the milker, and refuses milk as soon as the calf is removed; the best modern cows secrete in their greatly distended udders up to twenty quarts and over a day, and although the calf is removed within a week or ten days after birth, the lactation period extends from eight to eleven months.¹ Sheep have been similarly improved as respects their yield of wool. The average weight per fleece in the United States in 1900 was about six and seven-tenths

¹ Records of milk yield are kept by lactation periods. The highest Guernsey milk record known at the Connecticut Agricultural Experiment Station is 12,855.5 lb. of milk in one period: a cow of this breed weighing 1150 lb. gave 11,219 lb. of milk in one lactation period, containing 602.91 lb. of fat, equivalent to 753.5 lb. of butter. A good cow should give 5000 lb. of milk in one period; and the period may extend to within a few weeks of the birth of the next calf. These figures were personally communicated by Dr. E. H. Jenkins.

pounds, and this figure is taken to represent an increase of at least one and four-tenths pounds since 1880; "in the fifty years since the first agricultural census, the average product of wool per sheep has increased approximately 140 per cent." Modern breeds vary a great deal one from another in weight and quality of fleece; the Cheviot bears coarser and less dense wool; while the merino ram, with his loose skin affording a great area for the growth of wool, yields from twenty to twenty-four pounds of a very high quality.¹ Naturally, since the sheep has been so greatly altered since its first domestication, we can make little reliable comparison of the domesticated and the wild breeds; but we are told that the merino may have 48,000 fibers to a square inch of skin, where the old German sheep had but 5500. The domesticated duck lays about ten times as many eggs as the wild duck. Among domestic fowls some breeds of chicken rank as "everlasting layers," and others as setters; by selection a pure white, yellow-legged variety has been developed out of forms usually variegated in color; game and bantam breeds form extremes in two directions.

159. Conditions and localities of selection. In all these ways man takes advantage of the laws of nature to accomplish his own better success in the struggle for life. It must be understood, however, that he is able to make no new varieties except by adding up or neutralizing such variations as are presented to him by nature itself (§ 135). He is obliged likewise, at the outset of his breeding activities, to take such plants and animals as are present in his neighborhood. Nor are all animals easily tractable; some resist all attempts of the domesticator; others cannot live or cannot breed in confinement. Few members of the cat tribe can be considered as ever having been truly domesticated; some birds of prey are unable to lay fertile eggs in captivity. The elephant, retained under domestication only a few hundred miles, perhaps, from his natural haunts, is normally unable to reproduce. The fundamental limitations to man's activities, referable to natural conditions and laws, must be kept constantly in mind if we are to get an undistorted view of the truth. We must also consider the status of the men who are doing the breeding; in order to embark at all upon such undertakings, man must have a certain mental endowment, and especially foresight. It is a fact that scarcely any of the world's important domesticated plants or animals — those which contribute much to the stream of commerce — have reached their present form through the agency of savage peoples.

¹ L. H. Bailey, *Cyclopædia of American Agriculture*, III, 610 ff.; Twelfth Census of the United States, V, ccxv-ccxvi.

Darwin has enumerated the following conditions as favorable to artificial selection of plants or animals : a high degree of variability ; great numbers ; propagation in great numbers and at a quick rate ; ease in preventing crosses. High variability and great numbers afford more and wider diverging chances from which to select ; without variability there would be no " choice " (or selection) ; without high variability no extremes to select. Propagation in great numbers keeps up these chances, and if the generations follow each other closely there is more opportunity to apply and to correct methods of selection. A doe rabbit has her first litter at the age of four months ; thereafter she litters eight times per year, having about eight young at a time. Assuming that all their offspring live and reproduce at this rate, two rabbits would have at the end of the third year of breeding some 13,718,000 descendants. Comparing this total with that attainable by the slowest breeding of animals, the elephant (which, commencing at the age of thirty, breeds only six times in the next seventy years), we can see the importance for selection of a rapid sequence of generations. Supposing these two animals to be domesticated, a man beginning at the age of twenty-five to breed the former could, at the age of sixty-five, have observed and selected from some 320 generations ; during the same period he could have observed only one new generation of the slower breeding animal. His chance to mold the former would have been far superior to what it could have been in the case of the latter. Again, prevention of crossing is absolutely necessary in preserving and building up a breed. There are few animals that will mate for life like the pigeon, and isolation must be effected in artificial ways, by inclosure, etc. Now the savage will not be sufficiently intelligent to persist long enough to develop a real new breed ; and because he is not sedentary in habits, or does not make and keep up his inclosures, his breeds are constantly in danger of falling back by mixture with less developed forms. We should hardly expect, then, that the best domesticated animals should originate in regions of low civilization. To take examples : there is no domesticated animal or plant of the slightest importance from Australia ; there are few or none that are worth domestication, and if there had been, the natives were never equal to the task. There are few or none from Africa south of the Sahara, certainly none that bulk large in the history of commerce. The African elephant has not been tamed, let alone domesticated. The native vegetable exports of central and southern Africa are mostly the products of plants that grow with little or no care, and in an unimproved form — palm oil, bananas, rubber, etc. Durrha and

possibly coffee, from southern Abyssinia, may be exceptions. The animal products are generally the spoils of the hunt, e.g. ivory or ostrich feathers. And when we turn to the New World the case becomes the clearer. Of the actually cultivated and improved vegetal products contributed by the American aborigines to the world, maize, manioc (the plant from which tapioca is made), the potato, sweet potato, tomato, some varieties of cotton and indigo, and tobacco are practically alone. How much "improvement" was made, say on the manioc, is questionable. The cacao, coca, agave, cinchona, vanilla, and capsicum had been utilized almost as they occurred in nature; the *quinoa* seed never attained commercial importance. If there were other half-developed grains and plants, they quickly succumbed to the competition of similar Old World flora. The case of the animals is the more striking, for prevention of crossing is perhaps harder with beings not chained to the soil. The only domesticated animal native to America that has any claim to importance in the world at large is the turkey, and that was domesticated by Europeans (§ 234). It is probable that the Americas contain but few fauna apt for domestication; it is doubtful if the llama, vicuña, and alpaca would ever have made good beasts of burden, at least not without the most discriminating and age-long selection. The richness of the field for hunting undoubtedly held back the development of domestication. But it is certain that the net product is very small, considering that the Americas form one third of the world's land mass and afford a diversified environment suitable for the development of a large and varied fauna.

160. Eurasia the center of early domestication and breeding. If now, in our search for the source of the world's domesticated flora and fauna, we turn to Eurasia, the tale is different. Practically all the grains but maize, all the fruits, all the spices and condiments, all the textile products, vegetal and animal, and practically all the domesticated animals come from this region. It is impossible to be exact and definite regarding such questions of origin, but it is likely that the majority of these products, especially the most refined of them, came from the regions of ancient civilization: the valleys of the great Chinese rivers, of the Ganges and Indus, the Euphrates and Tigris, and the Nile. These were the locations where the natural and the human elements united to render selection and improvement possible and even easy.

The following improved products are referable to the regions of ancient civilization in the Far East (China, India, Malay Archipelago):

rice; possibly millet; the orange and lemon; citron; shaddock; sugarcane; pepper, ginger, cinnamon, cloves, nutmegs, and some other spices; tea; opium; most of the cottons; Manila hemp; China grass; some varieties of indigo. Plainly several of these are simply taken out of nature and not "improved." The Asiatic and European plains in the neighborhood of the Caspian probably saw the origin and partial domestication of rye, oats, and hemp; buckwheat seems to have been domesticated somewhat farther to the north. To Europe are assigned the turnip, beet, asparagus, hop, some varieties of apple and pear; to the Asian steppes certain melons, gourds, etc. If now we look for the regions of Eurasia to which the rest of our important domesticated plants are referable, we find them in western and southwestern Asia and in neighboring parts of Africa and probably Europe. If one leg of a compass could be placed upon ancient Nineveh and a radius of a thousand miles or so be taken, the perimeter of the circle thus described would probably well include the seats of the effective domestication of the great majority of our best cultivated plants: wheat; barley; spelt; some varieties of millet; sesame; onion and garlic; carrots and the like; the pulses (pease, beans, etc.); the olive; date palm; fig; pomegranate; plum; apple; apricot; pear; cherry; peach; all the best vines; coffee (Arabian); mastix; flax. Most of these are highly refined products, the results of long selection, and are far removed from the forms as found in nature.

It is sometimes possible to localize these origins a little more definitely, but in the majority of cases this is precarious; for the purpose in hand some such general perspective as the above is sufficient.

If we turn now to the origins of domestic animals, the case is not so different from that of the plants. To the Far East (including India) may be assigned the swine; silkworm; domestic fowl; pigeon; peacock. Here only was the elephant tamed (not domesticated). For the rest we must look to the central plains of western Asia and to the region included within our imaginary circle. Naturally a wandering folk is much better able to domesticate and breed animals than plants; it is therefore likely that these processes were partially carried out before the animals were subjected to the more searching selection (under isolation) possible only in the centers of culture. From western and southwestern Asia came the goat and sheep, the camel and dromedary, ass and horse. Of the horned cattle a variety (carabao) is found in the East; the better western breed was developed probably in western Asia. The bee is an Old World product. The reindeer was tamed first in arctic Asia. No region of

domestication can be assigned with any safety to the cosmopolitan dog, cat, duck, goose, etc. It is, however, certain that none of these latter, in the cultivated forms which we know, originated in the Americas or Australia; in these continents what domestication there was, was local and so remained; even the llama of Peru never made its way outside of the South American plateaus. The weight of probability goes to show that the development of the best breeds of both plants and animals is possible only to people of a relatively high civilization, as evidenced by density of population, sedentary life, intellectual superiority, technical skill in isolation and selection, and the like.

The artificial distribution of the domesticated flora and fauna will appear under later sections of this book (§§ 214, 234, 239, 240, 241, 242, 243). It may, however, be reiterated here that the laws of acclimatization (§§ 143, 145 above) have to be strictly observed, and that, in general, artificial distribution consists in the conveyance of the plant or animal to a region essentially identical with the original habitat, or artificially rendered so. The tree from whose bark the drug quinine is derived demanded the drenching rains of the eastern Andes; and it would not thrive elsewhere until the British had ferreted out, in their broad dominions, the almost exact counterpart of its native environment. If the new home is identical or nearly identical with the old, of course there is no hindrance to this spread; but with every difference, adjustment to which requires much artificial aid, the growing element of cost renders what is physically difficult commercially impossible.

INORGANIC MATERIALS

161. Influence of the distribution of inorganic materials. Thus far in this chapter we have considered only organic products, and we have treated of them first, inasmuch as the conditions of their life and distribution are so closely connected with the topic of climate with which we began. But there are many inorganic substances which likewise enter into trade because they serve either as repair to the waste of the body or as essential materials in the development of the apparatus of civilization. The distribution of water (§§ 81, 94) and of salt is of prime importance to man as an animal; and that of the useful rocks and ores (§ 38) to man as a social being. The value of flint and clay deposits to early man is proved both by the series of combats for the possession of the deposits and by the extent of trade in the articles themselves (cf. § 182). The same might be said of salt, shells, and other like commodities. And when the desire to possess the precious

metals and stones became strong, the disposition of these treasures exerted a strong influence upon local and general history. For long ages the legend of the Gold and Silver Islands attracted the world, and the Discoveries Period was full of the search for sudden wealth in the shape of deposits of the precious metals or of peoples who could be robbed of the products which they had extracted from mines. Whole settlements have risen about productive lodes, and then dwindled with their exhaustion. Prospectors and adventurers rushed to the Indies, Spanish and Portuguese America, California, Australia, South Africa, Alaska, to be followed later, in some cases, by those who represented more settled occupations, and then by genuine settlers. Take especially the case of California. The rush of the "forty-niners" resulted in the creation of a wild, irregular, and lawless community. But it drew men to an almost unoccupied land, to learn of its value in lines other than those of the metal-extractive industries; and exploitation was gradually modified into rational development of resources. Development of national interests on the Pacific coast then motivated those extraordinary undertakings in the construction of railroads which ended by binding together in national unity and common interest regions 3000 miles apart and separated by barriers which, except for an extraordinary attraction, would have remained long insuperable (cf. § 302). Thus the presence of the precious metals has given a start to the settlement of countries which have later taken a higher place in the making of history and in the world of trade.

The history of American mining-towns presents many examples of the determining effect of mineral deposits. Butte, Montana, is a city of 62,000 inhabitants, supported by copper underlying about one square mile of land surface. The metal forms the sole *raison d'être* of this considerable settlement, for in other respects the region is unproductive and unattractive; without the mines the locality would support with difficulty a population of one hundred souls. The mineral deposits of Nevada occur beneath strips of land a few hundred feet in width and in the midst of a hopeless desert, but they have formed plausible pretext for adding a State to the Union and two Senators to Congress. The decline of the lodes has now reduced Virginia City to a population of 2500, as against 11,000 in 1880, when it was one of the busiest cities in America, in the midst of a superlatively "booming" State. In 1900 Nevada was credited with a population of 42,335—a figure somewhat under that for 1870; thus this State, with an area twice that of New England, has less population than Waterbury, Connecticut.¹

But it is not alone the precious metals which have determined human history. The wealth of England has lain in good part in the

¹ Gregory and Keller, "Controlling Conditions of Commerce," *Harper's Monthly*, March, 1908.

natural advantage it has possessed in the juxtaposition of its coal and iron deposits (§ 331), an advantage which accrued to us of America only after the development of rapid and cheap transportation had neutralized the factor of distance — when the physically difficult had been rendered sufficiently easy to become commercially possible. One might further instance the early connection of England with the Mediterranean nations, owing to the presence of tin in Cornwall; the prosperity of many sections of the world, due to the discovery of petroleum; the importance of the copper mines in the development of Lake Superior regions; and so on. The great prosperity of Pittsburgh, Pennsylvania, owing to the simultaneous presence of coal, iron, petroleum, and facilities for water and land transportation, is a case of a plurality of favoring conditions.

We have now considered climate and the character of flora and fauna as natural conditions which directly influence the life and activities of man, or which call forth in him his special powers of adaptation through intellectual processes; and we have touched upon the distribution of inorganic products. The bearing of all this upon the development of trade is obvious; if it affects man's very life it certainly affects all his activities; and if it affects the sum of his activities it certainly affects trade.¹ We turn now to another set of conditions still partially connected with climate, but depending more directly upon the forms of land and the presence or absence of water.

¹ The data of trade assembled in the later pages of this volume sufficiently demonstrate this conclusion; it is the chief object of our writing to place behind the bald facts and statistics of commerce the underlying explanations which will render the study of the actual data something more than an exercise in ineffectual memorizing. It is manifestly impossible in this place to deal with more than generalities; but it is suggested to both teacher and student that a correct apprehension of these generalities will help them to explain local and variant cases for themselves.

CHAPTER IX

ENVIRONMENTAL INFLUENCES (*Continued*)

TOPOGRAPHY, DISTRIBUTION OF WATER, ETC.

162. Topographic influences in general. Diversifications of the surface of the land (§ 22 and Chapter II), determining as they do the forms of coast line, the general direction of drainage, avenues of communication, etc., exercise a very strong influence upon the life of man. The effect of elevation on climate has been explained in a former chapter ; thus we may have a temperate climate within the tropics or even under the equator, and resulting phenomena of human life approximately characteristic of such climate (§§ 51, 112, 148). The only advanced civilization native to the Americas was developed upon high plateaus, in Mexico and Peru ; Montezuma's capital lay at an altitude of about 7500 feet and that of the Incas was some 5000 feet higher. Altitude, however, with its accompanying thinness of air, also exerts a strong influence upon the human organism, rendering a people less energetic and progressive. Horses brought from New York could not race on the plateau of Anahuac ; and men are said to be incapacitated for the most strenuous efforts. The porters of Mexico city used to carry far lighter loads than did those of Vera Cruz. The civilization of plateaus, for this and other reasons (isolation, etc. ; cf. §§ 166, 170), has never reached the height of that developed in lower flat regions : contrast Mexico, Peru, or Tibet with China or Egypt. High plateaus are, as a class, the most unfruitful parts of the earth. Since "every elevation of ground diminishes the density of population, or, as it were, loosens it . . . , it is very significant that, of all the quarters of the world, Europe has the lowest mean altitude (§ 37). It is essential to all progress of culture that men should not be separated by great distances."¹

Again, the influence of altitude upon the life of many virulent disease germs is very marked : yellow fever, with its insect agency of propagation, never ascended higher than about 3600 feet — some say far less — above the sea level ; typhoid was unknown upon the

¹ Peschel, *Races*, p. 509.

Cordilleras; lofty stations are favorable to recovery from tuberculosis of the lungs.

Man is, as it were, a deep-sea inhabitant of an ocean of air; he is limited as to his expansion, not only in a perpendicular direction but laterally over the floor of his ocean as well (§§ 55, 56, 59). He can attain great altitudes—he can climb Chimborazo (over 20,000 feet) or ascend to a height of over 35,000 feet in a balloon—but he cannot live there. His heart-beat is quickened, and the symptoms indicating that the organism is out of its proper environment are exhibited. The highest inhabited places are not of an elevation of over 15,000 feet. In Italy only 0.3 in 1000 people live at an elevation of over 5500 feet, and only 7.3 per 1000 above 3600; elevations of 0–160 feet and 320–1000 feet show figures of 264 and 272 per thousand, that is, they harbor, taken together, over one-half of the Italian population. And, significantly enough, elevations in warmer regions are of about the same populousness as the colder latitudes to which they correspond: Alpine regions of an elevation of about 1600 feet show a density of population corresponding to that of Norway; high Peru and Mexico (above 8000 feet) have the density of Spain.

The following table shows the density of population at certain altitudes in the United States (1880):

ALTITUDE	POPULATION	PER CENT
Up to 100 feet	9,152,296	18
100–500	10,776,284	21
500–1000	19,024,310	38
1000–1500	7,904,780	16
1500–2000	1,878,715	3.7
2000–3000	664,923	1.3
3000–4000	128,544	0.23
4000–5000	167,236	0.33
5000–6000	271,317	0.54
6000–7000	94,443	0.19
7000–8000	15,054	0.03
8000–9000	24,947	0.05
9000–10,000	26,846	0.05
10,000 and above	26,078	0.05

The Mohawk valley, which cuts to a depth of about 140 feet between the mountains, exhibits a strip of country numbering 45 to 90 inhabitants per square mile between two strips numbering from 6 to 18. Naturally the conditions of communication have a good deal to do with these facts, as will presently be seen; but the underlying influence of altitude is not thereby minimized.¹

Other effects of diversification of land forms might be cited, for instance, that affecting rainfall and the formation of deserts (§§ 115, 120, 125). Mountains generally have a dry and a wet side, and if they shut off an interior, as in Australia (§ 361), from the vapor-bearing winds, aridity must result. In this place, however, we wish rather to

¹ Most of the above figures are from Ratzel's *Anth.*, I, 311 ff.; II, 211 ff.

emphasize a typical, and perhaps the most comprehensive, influence of topography—that which it exercises upon the relations of communication between human groups. It should be understood at once that extreme isolation is unfavorable for the development of civilization. No single group can develop culture, material or other, for it is by the conflict, comparison or exchange, and accumulation of the ideas of many that a fund of civilization is produced. It is only where there is a severe struggle between numbers of forms of plants and animals that the most highly developed stocks arise; and the same is true of human affairs—there must be competition to force advance (§ 135). The effects of isolation may be seen in the provinciality of remote towns in America; and in their extreme in the case of such groups as the inhabitants of deserts and remote islands. In general, a type of country that favors movement will favor the growth of civilization along with that of trade. Let us now consider topography from this view point.

163. Land transportation. What man has to overcome in his movements is the inequality of surfaces, i.e. friction; and, in a general way, the extreme inequalities between mountains and plains may be viewed as a sort of friction, entailing extreme effort in movement. Taking up specifically land communications, it will be seen, then, that the peoples of plains have a great advantage over those who live in a broken country. Mountaineers dwell in small groups in narrow valleys, cut off from the rest of the world; so do oasis dwellers, for the oasis is, as it were, an island in a sea of sand across whose surface passage is superlatively difficult—and the desert, like the sea, has its pirates; plain dwellers, on the contrary, exist in larger numbers, move about and collide or coalesce with other groups. If the plains are very fertile, i.e. well watered, a dense population may be supported (§§ 165, 173). Consequently, the former types are backward and conservative; the latter advanced and progressive. It is a case of isolation versus non-isolation. The very origins of our civilization in general, as well as of such acquisitions as domesticated plants and animals (§§ 159–160), are referable to dwellers on plains. Civilization is a product not only of numbers but of the frequent contact of numbers as well.

The destiny of a people, if it meets barriers to communication, depends largely upon the relative difficulty of the latter, and also upon the power of the groups to react upon and overcome them. Of all physical barriers the mountains and deserts are the most redoubtable. One of the conditions favorable for the rapid colonization of the

Americas was the fact that all the great mountain ranges lay in the west (cf. §§ 61 ff.). The eastern ranges in both North and South America are low and are pierced by relatively easy passes; if the Americas had been approached from Asia instead of Europe, there would have been a different tale to tell. It took all the momentum of a rapid advance of large bodies of settlers from the Alleghenies to the region beyond the Mississippi to carry population and governmental unity across the Rockies; the Andes are surmounted by a railroad, the momentum for the building of which came mainly from the side of the Argentine Republic. The power to overcome topographic barriers to free communication is, of course, a measure of intellectual adaptation or of civilization (§ 139). It is significant that it was the North Africans and Europeans, not the Sudanese, who penetrated the Sahara. No such penetration is possible until a people has acquired some "ship of the desert" or, later, some "iron horse."

164. Motive forces, roads, and vehicles. One of the important reactions of man on nature is here suggested: the development of means and ways of transportation (§ 291). First of all, of course, man was his own pack animal; then in the course of time he developed such diverse and variously adapted beasts as the reindeer, dog, ox, yak, ass, mule, horse, camel, dromedary, elephant, and llama. Much later he advanced to the "domestication" as motor power of actual nature forces—heat, steam, gas, electricity. A large amount of skill and ingenuity was also expended in obviating and minimizing friction, in the case of the development of vehicles and roads. From the sledge or drag, pulled by main force over a variety of obstacles, advance was made to rolling friction by the invention of rollers and of a solid wheel and axle. The wheels were then made lighter, spoked, and allowed to revolve about a stationary axle. Roads were cleared and improved to correspond with the new vehicle. Speed and comfort advanced with these improvements until now we see the light, motor-driven, rubber-tired vehicle on a road of macadam, brick, wood block, or asphalt. Upon a good macadamized road a horse can draw up to two tons, that is, about twenty-five times what he could carry as a regular load on the back. On a tramway, it is said, he can draw a weight of 33,000 pounds, the pack load of 150 horses.¹ We see more: enormous railroad trains roll, with smooth wheels and lubricated axles, upon narrow ways of polished steel. To better the road for these gigantic vehicles, cutting, tunneling, bridging, and filling-in on a large scale are everyday matters, undertaken often for the saving of

¹ Bourdeau, Forces, p. 95.

minute fractions of time, or to avoid the strain and wear of grades and curves. By such smooth and speedy communication, along with annihilation of time and distance, isolation is invaded, and civilization may proceed with accelerated pace.¹ Herein lies a victory of man over the resistance of natural barriers and of the contact of surfaces.

It has been estimated that the exertion put forth in the transportation of a given weight over a given distance varies with different types of vehicle and roadbed as follows: "Upon a natural land-surface, not levelled, but clayey and hard, the relation of draught to weight is 0.250, that is to say, 250 kilograms descending on a pulley would move a burden of 1000 kilograms. Upon a natural surface, not levelled, but flinty or chalky, the relation is reduced to 0.165. Upon a ballasted road in the usual state of maintenance, it is 0.080. Upon a macadamized road, perfectly maintained. . . , it descends to 0.033. Upon a road with flat [tram] rails . . . it is reduced to 0.010. Finally, upon a railroad with edged rails it is not over 0.007, and even, if the axles are kept well lubricated, 0.005."²

It is wellnigh unnecessary, when the books and magazines are so full of descriptions of man's "labor-saving" devices, to say anything upon this subject. However, the following quotations may serve to place in its setting a topic that should not be overlooked. Each advance in the arts means an economy of some sort: "in England the subsistence of a laborer cannot be reckoned as less than 60 cents a day; but that of a horse, equal to seven men, amounts to only 40 cents; and a horse-power, which represents two horses, is obtained with a quantity of coal whose price does not exceed 8 cents." Again, "a locomotive, run by an engineer and fireman, draws a load of 660,000 pounds a mean distance of over 90 miles a day. The same labor performed by men (at the rate of 1540 pounds transported about three-fifths of a mile over level ground in one day) would call for 64,000 carriers. The 20,000 locomotives which Europe boasted in 1869 would thus replace 1,280,000,000 men."³ At this rate a few more locomotives would, with the 20,000, have done work equivalent to that of the population of the world. This calculation was made on the basis of conditions existing forty years ago; what the various mechanical devices are doing now, and will do in the future toward the increase and economy of man's power, may be left to the imagination.

¹ A contrast between conditions of communication in Ecuador and those to which Americans in the United States are used may render our contentions, commonplace enough if they are not attentively scrutinized, more vivid. In Ecuador the means of internal communication "are in such an extraordinary condition that people in different parts of the country are absolutely strangers to one another; so much so that the notes issued by the banks in the capital, Quito, are *not current* in the chief port, Guayaquil. The so-called roads are generally mule-tracks, which are practically closed throughout the rainy season, i.e. for half the year; and, where there is no ready-made mule-track, recourse is had to the bed of a torrent which has ploughed a fairly distinct channel through the loose volcanic soil. Even over the main track from Quito to Guayaquil merchandise cannot pass at all during the winter; and a mounted postman has actually been drowned in the mud in attempting to carry letters between the two cities. Even in the open season goods sometimes take *six months* to travel over the 200 miles of land between Bodegas and Quito" (Lyde, *Comm. Geog.*, pp. 37-38).

² Bourdeau, *Forces*, p. 95.

³ *Ibid.*, pp. 220, 239, 240.

165. The distribution of water. Reserving a further discussion of methods and routes of land transportation for later pages (§§ 184 ff.), we now turn to the influence, not only upon trade but upon man's whole life, of the distribution of water. Since the body of an adult is composed of about 58.5 per cent of water, as against 41.5 of firmer material, it is clear that to repair its waste (cf. § 152) water is quite as necessary as more solid food. We find, therefore, that the distribution of man on earth is determined largely by the water supply; that large stretches of desert are unoccupied, and that population tends to mass itself in well-watered districts. In later times the importance of water power has been very great, as is shown by the tendency to settle along the foot of elevations from which rivers descend to the coastal plain. This tendency, as has been seen, was very plainly marked in the early history of the Atlantic coastal plain in the United States (§§ 46, 62, 93). The physical forces that regulate the distribution of water have already been discussed (§§ 120, 121). For the preservation of his body the ordinary man must have some three to four quarts of water daily (§ 81), the actual amount of water-drinking depending upon the amount of the fluid in his food. But the element must be there, and is taken, in all probability, in much greater quantity than the amount strictly necessary for the restoration of bodily waste. Now we know that man may accustom himself to less than the average amount of water taken, or, at least, to drinking at longer intervals. Desert dwellers, like the Bedouins, drink infrequently and sparingly; members of one of the Sahara tribes are said to endure thirst with apparent ease for four days; like the fauna of the desert, e.g. the camel, they exhibit a plainly marked adaptation of habit, and very likely of physique, to their environment (§ 136). Aside, however, from these extreme cases, we find the movements of men more largely controlled by the distribution of drinking water; whether the liquid finally arrives in their bodies directly, or via plant or animal food, is of little moment. Settlements tend to rise about springs or upon river banks; the charts of prehistoric finds show that primitive groups almost invariably located near a body of water (cf. §§ 88, 92, 94).

166. River valleys the foci of early civilization. This happens, of course, not only because human life depends upon moisture, but also because the location of the plants and animals upon which man relies for the continued restoration of bodily waste is likewise determined by the distribution of water. Confining ourselves for the moment to the waters of the land, it is clear that terrestrial and amphibian, not to mention aquatic, fauna were naturally more prevalent in river

regions. It is not at all strange, therefore, that population has concentrated, especially in former ages, in fertile river bottoms (cf. § 59); and if we bear in mind that concentration of population and growth of civilization go together, we see that it is not by chance that the origins of the world's culture have been found in river countries, and chiefly in the alluvial deltas. Moreover, despite the fact that they are conveniently used as political boundaries (§ 88), rivers have never constituted real barriers to communication, but rather the reverse. Chinese civilization arose in the valleys of the great Chinese rivers; that of the Hindus about the Ganges and Indus¹; that of the Assyrians in the river island of Mesopotamia ("between the rivers"); that of Egypt close by "Father Nile." From these regions came many of the products of domestication and selection, processes most successful where physical conditions were most favorable and civilization most advanced (§§ 159, 160). Here were the first great cities — agglomerations of population between which, naturally enough, the routes of trade were bound to stretch.

And this characterization can be further extended. In the wide, well-watered valleys of river systems was plenty of space for expansion and for the formation of a great people. The inertia of such is represented by the persistence of their type of civilization even when they are in subjection; they are able to absorb their conquerors and pursue their way virtually undisturbed, as China did after the eruption of the barbarian Mongols. But their way is the way of civilization; hence the persistence of culture despite the apparently overwhelming inroads of barbarism. The power with the "hinterland" will regularly prevail over the one that has no such space in which to throw out its roots, as is shown in the case of the conflict between Rome and Carthage.² One of the reasons for the higher development of civilization in the northern hemisphere is that the climatic and other conditions favorable to such development are so restricted in their areas of application in the southern continents. The temperate regions south of the equator, which are at the same time well-watered plains, are extremely limited by the shape of the land masses (cf. §§ 127, 128). Furthermore, the existence of plenty of available land causes a demand for men, and gives rise to a population policy that works toward the strengthening of numbers and toward the development of ideals of equality, independence, and progress; for example, in the settlement of what is now the United States.

¹ The Chinese say that they became civilized when they got down in the river region; the influx of the Aryans into India is well known.

² Ratzel, *Anth.*, I, 165, 180, 188.

Thus regions showing little irregularity of surface have their characteristic life as determined by the presence of abundant moisture, and the absence or rarity of the latter is equally determinative of other types (§§ 122 ff.). It may be said of the desert type that the necessary limitation and dispersion of population prevents any very great advance in civilization. A characteristic life is lived also in the sub-arid grassy steppes or prairies. They are the great cattle-raising areas, with a population which seldom or never forms large groups, but which is in earlier times nomadic, moving from place to place with the flocks, either to arrive at new regions of water supply or of more abundant vegetation, and rarely developing a more than semi-civilization. This suggests the principle that sedentary life is more favorable for the development of culture than is nomadic life, a principle seen upon reflection to be perfectly self-evident. Continuous change, the frequent upheaval, overturning, and consequent disorder of social life are as unfavorable for the higher development of civilization as is isolation for its beginning. Once well started, civilization becomes a matter of the accumulation of instruments, arts, etc., which aid in the struggle for life; of property and capital, which represent in reality energy stored against this struggle. Much of such accumulation becomes fixed; civilization thus acquires or invests in an *apparatus* which cannot well be shifted. This deserves further illustration. The higher the civilization the more extensive is the investment that man is required to make and the more "tied up" does it become. It would be generally admitted that to plant and reap is a more civilized proceeding than to forage in nature for what can be picked up. But the former implies the investment of labor and capital (seed) in the ground and the sojourn of the investors, at least for a time, in the neighborhood of the crops. If, now, trees and vines are planted for whose fruition it is necessary to wait months or years, the sedentary character of the cultivators' life must be further accentuated. To take still another illustration: the more the domestic "plant" is developed the more fixed must the family or group become. When this plant is represented by a tent, a few robes, mats, pots, and kettles, the shifting is as easy as it is for a camping party or a band of gypsies; the whole establishment is in some cases on wheels. But when the home becomes large and strongly built, the furnishings more numerous and bulky, and so on, movement becomes difficult and all but impossible. These examples serve to illustrate the commonly accepted fact, so strenuously insisted upon by missionaries, that sedentary life and high civilization go together. They also cast light upon a foregoing statement, that

natives of the wide steppes seldom if ever develop more than a semi-civilization.

167. Manipulation of the water supply. But man has in time reacted through intellectual adaptation upon conditions of this character, and where moisture is not freely given by nature, he has learned to employ artificial means of supply. His attempts along this line were at first extremely crude, consisting of the enlistment of magic on the part of medicine-men. One of the great functions of the magician among dwellers on dry plains is "rain making"; in fact, the whole life of the people revolves about the attainment of rain, the operations calculated to cause the spirits to send it, and the like. Within the last years we have seen numerous attempts to cause rain artificially. These are sometimes based, even though mistakenly, upon rational procedure; indeed, many ages ago men devised rational measures, if not to produce rain, at least to extend productive areas by the artificial distribution of water (§ 95). The practice of irrigation is very ancient and widespread; by its means thousands of square miles have been reclaimed for human use. Aqueducts and other engineering works were constructed many centuries ago, especially by the practical-minded Romans. In modern times the processes of irrigation have been perfected; in the United States, in 1902, almost eight and a half million acres had been subtracted from scarcely habitable desert regions. In British India, in 1907, there were 55,928 miles of canals, etc., commanding 50,000,000 acres of culturable land, the area actually irrigated in 1906-1907 being 21,992,683 acres; and there are 42 projects under construction or awaiting sanction, designed to irrigate 6,280,000 acres. Probably the most interesting case of water storage and distribution has occurred in Egypt. The life of this country is the river Nile, whose annual overflow covers an otherwise desert area with an average of some three hundredths of an inch of silt, rendering it very fertile. The population which this country will support is really limited by the productivity thus induced; consequently the effort of man has been for ages expended upon the artificial increase of the fertilized area. Attempts were early made to retain the overflow as long as possible in order to profit by a greater precipitation of mud; this was at first done by the use of little canals, flood gates, etc. In the middle of the nineteenth century (1861), however, there was completed a barrage calculated to hold back the whole river at the delta, and thus cause it to overflow a greater area. The annual cotton crop increased to about five times its earlier figure as a consequence. But it became apparent about twenty-five years ago that the limit of this

dam's utility had been reached ; for the further development of population, products, and comfort some new application of art was needful. This led to the construction of the famous Assuan Dam, opened December 8, 1902, at an expense, counting accessory works, of something over \$100,000,000. By this means the water supply is immensely increased ; the dam stores 1,000,000,000 tons of water, enough to supply fully every town and village in the United Kingdom for one year. This supply can be retained or released according to the varying needs of the different years or seasons ; the sluices may be opened early in March, and for four months a good head of water for irrigating purposes can be maintained. By means of irrigation devices Egypt has, with some intermissions, won up to 20,000 acres annually for cultivation. The effect upon the disposition of the cultivators has not been slight ; the inhabitants know now that crops will not fail them, for they are independent of the variability of rise in the waters. When several projected improvements shall have been made, including the raising of the dam sixteen feet, the whole river from the lakes to the sea will be under control. It is by such stupendous operations that man has come to be regarded as nature's master ; but it must be constantly borne in mind that the limits within which he can work are after all very narrow, and that in his endeavor to "control" nature he is soon brought to face elemental forces against which all effort is futile.

168. Proximity to seas and oceans. We have seen, then, the influence upon human civilization — and so upon the production of merchantable commodities — of the distribution of rainfall with its resultant effects upon soil. We purposely reserve the discussion of the routes of trade, as determined by reservoirs or streams of water, for a later chapter (§§ 186 ff.). But we have not yet considered the effects of proximity to seas and oceans, composed prevalently of salt water, upon the life of societies.

Nearness to large bodies of water determines to a high degree, as has been seen (§ 113), the type of climate ; and the effect of the latter upon man has been sketched (§§ 142 ff.). Inasmuch, too, as the coast dwellers are not much above sea level, the factor of altitude also is to be considered (§§ 112, 162). Here, however, we wish to emphasize the importance of large bodies of water as sources of supplies of food, etc. ; and as constituting an environment which calls forth special (i.e. maritime) activities on the part of man. It is plain that the seacoast combines the productivity of land and water ; that dwellers near the sea have lived largely from its spoils is attested

by the prehistoric heaps of shells (*kitchen-middens*) found along the shores of many lands, and still in the process of formation in some regions like Tierra del Fuego. In addition, many instances could be given of whole societies which subsist largely upon the creatures of the sea; for example, the Eskimo, the Polynesians, Northwest Indians, and many other coast dwellers and islanders. Fishing was the occupation which led the northerly nations to the New World and motived the settlement of parts of it; whole districts of New England once depended upon the cod and whale fishery for their livelihood. The denizens of the coasts have always had a fairly regular supply of food open to them; and the same thing may be said of the settlers along rivers, this constituting an additional motive for the early occupation of such regions (§ 166).

The desire to appropriate the products of lakes and seas had a strong influence upon the type of industrial and social life. Pile-dwellings assembled to form aquatic villages date from antiquity, and are found in the lakes of Switzerland, on the coast of Venezuela ("little Venice"), of New Guinea, and elsewhere; and doubtless one of the motives for such a life lay in the desire to "fish from one's doorstep in one's backyard." But this was a relatively unimportant result of life on shores of seas; the prime significance attaches to the development of shipping, and of what has been called a "thalassic" as distinguished from a "potamic" or "oceanic" type of civilization and of trade.

169. Water transportation. The reason why the ways of trade have been so largely water ways is simple enough: water is the one fluid yet supporting element widespread in nature. Being fluid, its molecules move upon each other with freedom, minimizing friction. And it will hold up or float many materials at man's disposal for the making of water vehicles.¹ Here it clearly outdoes the air. If he

¹"Water carriage, by river, canal, or sea, is cheaper than land carriage, because the water itself bears the weight, and only motive power is needed. For instance, the same horse that could only draw *one* ton in a two-wheeled cart can draw *forty* tons in a barge! Consequently, goods that are very heavy or of little value must be carried by water; and this fact will for a long time impede the development of, e.g., copper mining in Australia, or iron mining in South Africa. The comparative cost of some different kinds of carriage may be estimated from a transaction which took place in 1892. A London merchant bought 200 tons of second-class flour in Liverpool. Sending it to London by rail was out of the question, although the London and Northwestern Railway rates for *through* carriage between the two places are so small as to do little more than pay the cost of movement; and the local sea rate was such a trifle less than the land rate that it paid the buyer to ship the flour from Liverpool to New York, and then from New York direct to London at *through long-distance rates*!" (Lyde, *Comm. Geog.*, pp. 44-45).

could have done so, man would long ago have taken to the latter element. It is clear, then, first of all, that a country with many natural water ways is favored for the development of internal communications. But the presence of natural water ways is due, of course, partially to the influence of local land forms. Hence the topic of local water ways (rivers and lakes) naturally follows upon a consideration of topography.

Naturally, also, the first water ways to be used were the rivers, as being smaller and more sheltered; hence the term "potamic" as applied to the most primitive type of commerce. It is sometimes called "continental." Where the undergrowth was so thick as to be practically impenetrable, streams offered broad and smooth avenues for the passage of men and goods. Inland lakes augmented these facilities,¹ though the development of shipping amounted to little before it encountered salt-water conditions. It is when we come to an island-dotted or inclosed sea (*thalassa*, or *mediterranean*) that we observe the conditions which call into being commerce of a more than intermittent or local order. The only localities in America where the natives developed a seafaring life of a relatively high stamp were in the Arctic archipelago, on the northwest coast of North America, the southwest coast of South America, and in the Caribbean Sea. But the Americas, together with Africa and Australia, may well be said to have developed of themselves no external communications. In Asia the foci of ancient maritime activity were the Malay Archipelago, the China and Yellow seas, the Red Sea, and the Persian Gulf. In the Pacific the Polynesians were almost forced to develop shipping and nautical skill of a relatively advanced type, in order to voyage from one small low-lying island to another. In Europe the Baltic and North seas saw the rise of the Vikings and the Hanseatics. But it was the Mediterranean Sea alone that was the cradle of modern commerce and the school of modern navigation; this sea, for the development of trade, possessed advantages over all the rest. The eastern Mediterranean and Ægean, full of islands, afforded a fit stage for the operations of untrained and timorous mariners; while toward the west progressively increasing distances between halting stations encouraged seamen to bolder ventures as soon as they were ready to undertake them. Thus the Phœnicians, and the Greeks after them,

¹ It is estimated that lakes cover 0.9 per cent of the area of European Russia, 1.3 per cent of that of the United States, 3 per cent of that of Norway and Ireland, and 8 per cent of that of Sweden. Their presence tempts men to learn to build craft; even the negroes of the lake region of Central Africa are already above the lowest stages of shipbuilding. See Ratzel, *Anth.*, I, 261; II, 109.

were allured to the Strait of Gibraltar, and even beyond (§§ 194, 196). Along the trade routes thus formed grew the cities. No large city of ancient times was thinkable without a water way for the conveyance of provisions; the speediest method of conquest was the severing of these arteries of trade. Island position, affording the greatest freedom of water communication, has been a conspicuous factor in the development of great commercial cities, for example, Tyre, Venice, Singapore, Bombay, New York.¹ For many centuries, however, the open ocean was shunned; trade followed a composite route over inland seas and over land (§ 184). The ocean remained a barrier long after the seas had ceased, in ancient phrase, to "keep lands apart."² This was not because coast navigation really demands less skill and hardihood than that of the high sea; but because it makes less claim on what might be called moral courage. Many superstitions had to become antiquated, and many new ideas familiar, before mariners would brave the unknown. It was only about five hundred years ago that a persistent effort to utilize the open ocean as an avenue of communication began; and with this came the development of an "oceanic civilization" and of commerce on a grander scale and in a world market.

Parallel with this progressive utilization of greater water ways went a development of the water vehicle and the art of fitting it to harmonize with the demands of the medium in which it swam. The raft, coracle, punt, or canoe which was adequate for short voyages upon quiet waters needed improvements in order to be useful in a mediterranean. Better advantage could here be taken of wind force; and the art of sailing progressed with the strengthening of the craft against storms. Early navigation was done in the daytime only, and land was kept in sight; sails were used only when the wind was astern. Later, however, night voyages were made, guided by a constellation or star, or by the angle made with the wave crests (Polynesia); and the possibility was conceived of sailing into the wind. All this demanded development of hull models and tackle. When, now, the mediterranean model was tried upon the ocean, new changes were found necessary (§ 5); the ocean-going type of vessel was evolved, and gradually perfected up to that of modern sailing craft. The application of steam again altered the water vehicle, in one way

¹ Ratzel, *Anth.*, II, 477 ff.; I, 99.

² "Nequiquam deus abscidit
Prudens Oceano dissociabili
Terras . . ."

Horace, *Carminum* I, iii, 21-23.

and another, to secure greater seaworthiness, more speed, less motion, and so on. Study of the fluid element and the conditions of movement over its surface have gradually done away, as far as possible — as was the case in respect to the land vehicle — with friction and waste.

Land way and water way, land vehicle and water vehicle, have thus been modified toward each other, to secure the ease and rapidity of those communications of groups which, by breaking isolation, make for civilization.

170. Coast line and harbors ; isolation. After treating inequalities of land and distribution of water, it is in place to consider the line where land and water meet — the coast line. Here is the scene, first of all, of one of the greatest struggles of man against hostile nature. "If it is correct to say that civilization can be developed only in the struggle with nature, then the contest with the sea must occupy one of the foremost places."¹ The draining of great swamps is something, but the wresting of dunes and even of the sea bottom from the ocean, in an "amphibian land" like Holland, is certainly a grandiose conquest (§§ 21-25, 60).²

In considering the coast line, however, chiefly from the standpoint of trade, it would be unfair not to reckon in with the coast the banks of rivers at least to the head of navigation in large vessels. Multiplicity of navigable rivers replaces variegation of coast line, as in South America.³ The contrast between the possibilities of penetration of North America, from the east and south, on the one hand, and from the west on the other, scarcely needs comment. The fact that the uncolored parts of maps, i.e. the unknown regions, have been those farthest from such coast irregularities is very significant. As the variegation of land surface by water and of water surface by land is favorable for communication, so is the irregularity of coast line (§ 22). Take the extreme cases of Africa and Europe. Africa is three times the size of Europe, yet its coast line is only about three fourths as long; there are in Africa scarcely any natural harbors of the first class, while Europe numbers many that may be so called.⁴ Having covered

¹ Ratzel, *Anth.*, I, 259. ² See Goethe, *Faust*, Part II, 6946 ff. (Schröer's edition).

³ It is stated by Ratzel (*Anth.*, I, 275) that Hudson did not identify the stream named after him as a river until he had ascended nearly to the present site of Albany.

⁴ The *Port Directory of the Shipping World Year Book* (London, 1906) shows nearly a hundred European harbors (exclusive of those of the British Isles) of a high natural quality; those which are largely artificial have not been counted. Of the African harbors in the same Directory, and of a comparable present utility, there are only about a dozen, of which five are Mediterranean, and at least half very largely artificial.

the subject of land barriers and interior water ways, we are now in a position to develop this contrast further. Let us confine our attention to Africa south of the Sahara—"Darkest Africa." In all senses except the conventional geographical one, northern Africa belongs to Europe; ever since the Mediterranean became a pathway of commerce, it has joined north Africa with Europe rather than separated it apart. Regarding Africa south of the Sahara, in the first place the extent of ocean both east and west is unfavorable to approach by sea;

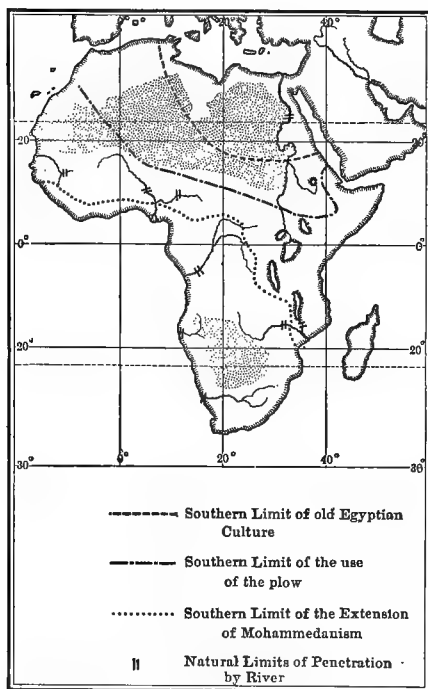


FIG. 20. Isolation of Africa. (After Ratzel)

and the presence of deserts on the north and southwest impedes seriously any penetration by land from the coast. The coast itself is relatively unbroken, affording but little protection for shipping or facility for disembarkation. In some localities, e.g. the Gulf of Guinea, the shelving shore is lashed by a surf which renders it necessary for ships to anchor in the open ocean two miles from land and depend upon the native lighters to deliver cargoes. In addition to these drawbacks to communication must be reckoned several others. Most of the important rivers have cataracts or falls not far from their mouths, owing to the fact that they must needs descend abruptly from the great plateau which forms the interior of the continent. These, or other obstacles, effectively impede penetration and opening up of the interior. For instance, the Congo River is navigable only to Matadi (about 150 miles); then occur 200 miles of cataracts; the fact that above the falls there stretch over 1000 miles of splendid water way had naturally no advantageous bearing upon the opening of the interior until a railroad (the great conqueror of geographical barriers) could be built around the obstruction. Again, land communication in the heart of Africa is extremely arduous. The jungle or the tall grasses

impedes seriously any penetration by land from the coast. The coast itself is relatively unbroken, affording but little protection for shipping or facility for disembarkation. In some localities, e.g. the Gulf of Guinea, the shelving shore is lashed by a surf which renders it necessary for ships to anchor in the open ocean two miles from land and depend upon the native lighters to deliver cargoes. In addition to these drawbacks to communication must be reckoned several others. Most of the important rivers have cataracts or falls not far from their mouths, owing to the fact that they must needs descend abruptly from the great plateau

are so luxuriant that the natives have never developed roads; their paths, worn by the bare feet of generations, are only two or three feet wide, and are not infrequently mere tunnels through the tropical undergrowth. Taking all these things into consideration, — and there are many other minor details,¹ — it is no wonder that Africa, though known long before the Americas and Australia, has remained the "Dark Continent" through the ages. What penetration there was came from the direction of Egypt and Arabia; the lines indicating the limits of Egyptian influence, the southern limit of the plow, and of Mohammedanism (fig. 20) clearly indicate the waves of foreign influence and the localities from which, like ripples on a pond, they spread. It is only within the last years that the large uncolored areas on the map of Africa have disappeared; and even when they occur no longer, the occasion of disappearance is the necessity of political delimitation rather than exhaustive exploration. With the case of Africa may be compared in many respects those of Australia and South America, though the latter continent was fairly well known, being penetrable by way of its rivers, fifty years after its discovery; contrasts with Europe, Asia, and North America are suggested at every turn and are sufficiently self-evident to be left to the reader's reflection.

The foregoing consideration of the case of Africa gives concrete point to the idea of Ratzel² about the "inner side" and "outer side" of continents. Most of Africa was until recent times "outer side," i.e. faced away from the foci of civilization. When the Arabs began to sail the Indian Ocean the east coast became an "inner side"; while at present, with the development of Atlantic trade, the west coast, and even the south, are more "inner side" than is the east. The cases of Australia and North America may with profit be considered from the same viewpoint. Curiously enough, because of the Spanish trade policy (§§ 208–209), the west coast of South America became the official "inner side" before the north and east, though the reversal of the natural order was strikingly shown by the wholesale development of smuggling, especially in what are now Venezuela and Argentina.³

171. Miscellaneous factors; summary. It may be useful, in order more fully to illustrate the determining influence of natural conditions upon the life of man, and so upon trade, briefly to indicate several other of these conditions and their results. Take the location of the ice line: the fact that Vladivostock harbor was frozen up for some three months in the year was one of the main reasons for the rise of Dalny, and for that attempt of the Russians to penetrate to the south

¹ Cf. Peschel, *Races*, pp. 471 ff.

² Anth., I, 111.

³ Cf. Keller, *Colonization*, pp. 245 ff., 317 ff.

which brought on one of the most destructive wars of history. Proximity to the open sea, or to ocean currents, is of great importance (§§ 18-19)¹: the Labrador current keeps land in the latitude of Ireland icebound for a large part of the year, while, under the indirect influence of the Gulf Stream, barley is ripened inside the arctic circle in Norway. Bordeaux is an open port when Sebastopol is icebound. A local coast stream aided Phœnician trade with Cyprus and Egypt; and even at the present day large steamers follow the Gulf Stream from America to Europe. Take the case of the winds (§§ 101-102): their presence or absence may mean that a section is healthful or noisome; their power is almost indispensable to a country like Holland; and their direction has largely determined the paths of ocean-going trade (§§ 114, 189-190). Take the presence of aquatic vegetation (Sargasso Sea, "sudd" in the Nile), the presence of fogs and icebergs on the "highroads of the sea" (Newfoundland Banks), etc. Of these factors,—and many others that will be suggested on reflection,—one and all exercise constant, even if local, influence upon the life of man and the course of trade (cf. §§ 15, 34, 88, 92, 101, 105, and fig. 21).

A comprehensive treatment of all such factors is manifestly impracticable in this place, even if possible. Enough has been said, perhaps, to demonstrate the influence of conditions of environment upon the life and activities of man and of human society. We have seen how this influence may be exerted directly, forcing man to a direct and unconditional adaptation; and how, in many other cases, environmental influences have awakened in man the power of intellectual adaptation—how man, by reflecting upon and studying nature, has been able artificially to perform adaptations which have secured his life, given him comfort, or rendered him able to attain his objects in a more economical manner (§ 139). The essential idea to carry away is the dependence of man, along with the rest of organic life, upon natural conditions. There is no danger that man will minimize his "power over nature," for his successes along this line are always before his mind and in his mouth, while failures are concealed or speedily forgotten. But there is great likelihood of his losing sight of the fact that he really "wins by yielding," that is, that his greatest "conquests over nature" really originate in skillful adaptation to

¹ The productions of those Eskimo who have access to abundant deposits of drift-wood (brought by the currents) are different from those of the tribes that lack wood; and thereby is the whole life of the former more richly endowed. See Ratzel, *Anth.*, II, 600.

the action of natural forces and to the influence of natural conditions (§ 141).

It will be observed that our instances taken to demonstrate this situation are largely derived from the earlier history of man. This is expedient, in order to make the contention clear. Viewing institutions in their simpler forms is like viewing a complex fraction in its lowest terms; modern life is so complicated, so crossed with various lines of cause and effect, that it is all but impossible to grasp its relations unless they are carried back to the simpler forms from which they developed. We do not intend to assert that all isolated social facts can be explained by reference to the influence of environmental conditions alone; for the structure has in generations been raised far above its foundations. Many a cornice and gargoyle may be added to a building with only distant reference to its fundamental structure. However, the solid walls of the edifice must follow closely the lines of its foundation, and the superstructure must surmount the walls, not empty space. We simply assert that environmental conditions such as we have described have been controlling conditions of human life and activities, and, among the latter, of trade. It is, in our view, indispensable for an understanding of commercial geography that the controlling influences which we have named, and others to which we shall refer, should be constantly kept in mind as the background upon which is evolved the immensely complicated mechanism of exchange. It is far from our purpose to treat this mechanism or its laws, — this is the function of the economist, — but we desire to exhibit trade as a specifically human activity in the prosecution of the struggle for existence. We have shown the distribution in nature of the materials of commerce, together with modifications brought about by human art; we have shown how different environments tend to modify the types of men — the producers, consumers, and distributors of these materials; how men react in various ways on natural conditions, thus producing different types of civilization, all of which may be viewed as being in varying degree favorable or unfavorable to the development of trade. We now turn to an attempt to fix the distribution of these different types of civilization, hoping thus to map out more clearly the areas within which different types of commerce are found to operate.

CHAPTER X

DISTRIBUTION OF THE AGENTS OF TRADE

172. The leading commercial regions and races. Having treated of the influence of natural conditions on men, the agents of trade, it is our object in this chapter to cover the distribution of these human agents, as we have covered in the above the distribution of the other factors which control exchange. The common physical distinctions of race — color, stature, resistance to disease, etc. — will here give us little concern ; trade is not much affected by such qualities. One is as ready to sell to the African as to the Indian. What we wish to know about different peoples is their degree of productiveness, their capacity for consumption, and the like ; in a word, we wish to treat of the distinction and distribution of men on the basis of their civilization. For the effectiveness of their participation in commercial operations will vary with the intellectual capacity of which their degree of civilization is a measure (§§ 139, 140).

The great civilizations of the present, as of the past, are products of the temperate regions (§ 148) : Europe, the United States, Canada, and the higher regions of Mexico ; China and Japan ; South Africa ; Argentina, Chile, and southern Brazil ; Australia, Tasmania, and New Zealand. Certain of these regions are behind the rest in development owing to the interference of other factors, e.g. isolation (§ 170) ; and when we consider the civilization of central Asia, of Ecuador, Peru, and other regions as yet remote from the highways of the world, this effect of isolation is the more extreme. The real centers of activity have lain along the seas and the ocean ; and their influence has penetrated toward the interior where natural communications have existed or after the development of transportation. It will be noted also that all of these countries which are or have been colonies naturally enough represent for a long time a type less developed than that of their countries of origin. In general, Europe represents civilization of a more settled and seasoned character, European colonies that of a more crude and youthful type. Again, the case of Oriental civilization stands apart, as one independently developed, but arrested far back in history, so far as advance in control over nature is concerned. In mapping

out the distribution of these peoples, then, we hope at the same time to locate the chief centers of trade development (see fig. 21 and § 198).

The other areas of commerce fall into a subject relation to these. Neither the cold zones nor the torrid have ever seen the origin of a more than local production and exchange, for they have never exhibited a civilization of any perfection. This is impossible of development in the arctic regions, for they are inhabited by a scanty population living on the very edge of things; nor in the torrid zone, inasmuch as its sometimes teeming peoples, owing to natural conditions, lack the qualities necessary for an independent advance in culture (§ 147). Both regions have become economically subject to the temperate regions as soon as the inhabitants of the latter have begun to display energy outside their own climatic habitat.

This broad classification of men on the basis of their civilization agrees to a considerable extent with the common classifications based upon color and correlative characters. The areas of civilization are the homes of the white and of the yellow race; while the tropics are the natural home of what is left of the black, brown, and "red" races. The arctic races, again, are prevailingly Mongolian. Where any one of the "lower" types did originally hold temperate areas (America; South Africa; Australia, Tasmania, New Zealand), they have yielded with comparatively little resistance to the encroachments chiefly of the whites. The upshot of the whole matter seems to be that the whites are better adapted to temperate regions, and that the "lower" types have little chance to persist except in the cold and warm ones. The yellow race seems to have little difficulty in acclimatization in any region.

173. Population and civilization. It is often asserted in this book that civilization is a product of numbers, and naturally the converse is true; to put it in another way, there is a close correlation between the growth of population and the advance of material civilization. That which arrests the growth of population retards the advance of civilization. Hence we should never expect to find great density of population outside of the temperate zones (§§ 147, 148), nor at great elevations (§§ 51, 162), nor in other locations unfavorable to man's "conquest over nature." By way of getting concrete facts before the reader, certain rough estimates of the density of population on the several stages of the arts — these stages representing in large part a reflection of environing physical conditions — are quoted from Ratzel's *Anthropogeography*.¹

¹ *Anth.*, II, 264-265.

INHABITANTS PER (ENGLISH) SQUARE MILE

Hunting and fishing tribes in the outermost regions of the inhabited world (Eskimo)	0.005-0.015
Hunting tribes of the steppe regions (Bushmen, Patagonians, Australians)	0.005-0.025
Hunting tribes with some agriculture, or deriving support from tillers (Indians, Dyak, Papuans, poorer negro tribes, Batwa) .	0.5-2
Fisher tribes on coasts and rivers (Northwest Americans, inhabitants of small Polynesian islands)	up to 5
Nomadic herdsmen	2-5
Tillers, with the beginnings of crafts and trade (inner Africa, Malay Archipelago)	5-15
Nomads with agriculture (Kordofan, Sennaar)	10-15
Mohammedan countries in western Asia and the Sudan	10-25
Fisher tribes practicing agriculture (Pacific islands)	up to 25
New countries with European agriculture, or climatically disadvantaged European countries	25
Purely agricultural regions of central Europe	100
Purely agricultural regions of southern Europe	200
Regions of commingled agriculture and manufacture	250-300
Purely agricultural regions of India	over 500
Regions of European large-scale manufacture	over 750

Thus, if armed with the apparatus of a higher civilization, thousands of men can live well in a region formerly affording a meager livelihood to a few families of hunters and fishers. Without going further into detail, the general aspects of the matter of population may be assembled something as follows: population increases immensely with advance of the arts; that of Europe doubled between 1800 and 1887 (rising from 175,000,000 to 350,000,000); while in the immediately preceding period it needed over a hundred years to accomplish this feat. It would now need little over fifty years. The Old World contains about 90 per cent of all men, the great areas of the Americas, Australia, and Polynesia harboring not over 7 or 8 per cent. Nearly three-quarters of the world's population live in Europe, India, and China, the other six-sevenths of the earth containing only about 500,000,000; yet the new countries represent areas capable of providing well for several thousand millions. Of the earth's surface only about 1 per cent shows 400 or over per square mile, and only about 6 per cent from 100 to 400.

Similarly on a less cosmic scale: the patches of population density are scattered, a large part of them being represented by the upwards of 75,000,000 people located in cities of over 50,000 inhabitants. In Europe, Saxony and Belgium show 500 and over per square mile, and a descending scale, explained by environment and occupation, is: Russia, 50; Sweden, 28; Finland, 17; Norway, 16; Iceland, 1.8.¹

"The increase of population means not alone density but also stability, and that which is stable is always conducive to culture."² But the fundamental factors of environment which condition the advance

¹ Cf. Ratzel, *Anth.*, II, 228 ff., 281, et passim.

² *Ibid.*, II, 285.

of numbers and culture should never be lost sight of in amazement over the successes of man. Consider the influence of the distribution of the grains alone (cf. §§ 157, 216 ff.) — they reach in general from the equator to 70 degrees north latitude, and of the following more specific limits each has its own conditioning effect upon population and culture: rice extends from the equator to the line of 54 degrees of mean annual temperature (§§ 117, 118), maize to 50 degrees, wheat to 43, barley to 36. "The density of population is therefore . . . a measure of the biologic intensity of the earth."¹

One further type of natural conditions, the human or social environment, must receive brief notice as bearing upon the question of population. Since the backward races do not migrate, at least not from continent to continent, to any great extent, any alien human environment in which they come to be placed will be formed by colonizing peoples; and these are almost exclusively of European origin. In the matter of brain adaptation to natural conditions, with a consequent increase of civilization, Europe easily leads the world and has led for centuries. Europe is actually succeeding in impressing her special type of civilization upon the world — even upon larger nations that once had a long start over her. Europeans, however, do not migrate in great numbers except to other, and generally only sparsely occupied, parts of the temperate zone — the so-called new countries. It is here that the large-scale effects of contact with native races are most in evidence. Not to go into detail of such contact, its effect upon these native races has been most disastrous; they have fallen before the strangers as their own local flora and fauna have declined before the "fitter" plants and animals introduced by the whites. The physical environment about them has been altered and they have not possessed the power of adaptation to novel conditions; it is quite comprehensible that they should have suffered from "home-sickness."² Hence, after the settlement of new temperate countries is well under way, the local population may be ignored as a factor in trade.

¹ Ratzel, *Anth.*, II, 206, 208.

² This whole matter is discussed in Keller's *Colonization*, Chap. I and pp. 257 ff. It is a wholesome warning to those who wish to "influence" native peoples, to note that the most benevolent purposes may utterly fail of good results. The Kirghiz blame their impoverishment through purchase of grain, and their more frequent famines, to the trade which enticed them from their old occupations. Their former status was one of satisfactory adaptation to their life conditions; the later one was not. Again, it was a bad thing when race benefactors freed the Hawaiians from the possession of their chiefs, for the latter had forced them to labor, which was good for them, and had then assured them of maintenance, of which they were, under the new conditions promoting idleness, bereft. Cf. Ratzel, *Anth.*, II, 351.

174. The commercial races. If now we attempt to characterize our types of civilization on the basis of their participation in trade, we find that commerce of any high degree of development belongs, as one would expect, to the yellow, and especially to the white race. Taking all the races, we can distinguish roughly two extremes — the highly civilized and the uncivilized types. With the former type and its activity all are familiar, for it is always before our eyes. It represents the ceaseless accumulation of power over nature — ever-increasing production, increased and widely diversified consumption, and, of a consequence, ever busier exchange. This is the type represented by the progressive states of Europe, and by the temperate colonies in America, Africa, and Australia which these states have founded or to whose growth they have contributed. It is not surprising, then, if the bulk of the world's trade is effected by the mutual "latitudinal" exchanges of these advanced peoples (fig. 22), brought about by division of labor and specialization between nations (§ 181). The Mongolian trader, while lacking in no respect in business enterprise and sagacity, has practiced in general an undeveloped species of trade, corresponding to phases passed through by the European nations long since. His entrance into the modern world market in a less subsidiary capacity has been largely due to his adoption of occidental methods.

175. The non-commercial races; the "native." A thoroughgoing contrast to European trade development is offered by the case of the uncivilized peoples. In the cold regions a hard life is lived from day to day, and there can be no division of labor producing surplus available for exchange. The very scarcity of population prevents these regions from entering to any extent into the trade of the world. A few furs are exported and unimportant quantities of goods, manufactured and other, are received in return; this kind of frontier trade is of little importance to our subject. When, however, we consider the case of the tropics, the real and the possible function of the "native" in the world's commerce cannot be dismissed thus summarily. The reason for this is that the tropics form tempting regions both of supply and of demand for the producers and consumers of cooler zones. The disposition of their inhabitants has thus been, and still is, of great significance for trade (cf. § 147). It is not necessary to go into detail here concerning the general character of "native" peoples; let us consider them in the light merely of producers and consumers; let us see how they fit or do not fit into the organization of the world's commerce. This is for them a very vital matter, it might be added, though they are naturally not aware of the fact (§ 177).

As an independent producer the average native of the tropics amounts to little or nothing. The effects of the climate, with that attendant and continuous luxuriance of nature, which relieve the struggle for existence of severity, render a tropical population, however dense it may be, less energetic and less provident than that of colder and more variable climates. Steady labor for many hours together is probably physically impossible in the tropics, even for a native; part of the day is regularly reserved for relaxation or sleep (§§ 143-145). Again, the expenditure of brief effort at considerable intervals is, under natural conditions, amply sufficient to afford satisfactory support. The productivity of the breadfruit tree secured by brief labor has been instanced above (§ 147); in certain tropical regions a worker needs about a dozen bananas per diem, and the bearing power of the banana is very great. About 1840 in the Hawaiian Islands a man could live on food worth only two or three cents a day; shipwrecked sailors got along very well for the same period on a cocoanut apiece. Little effort is necessary to provide the scanty clothing and the flimsy dwellings of the tropical peoples. Life being thus easy, the economic motive to effort in production is almost totally absent; were it not for the existence, in marked form, of vanity, the case would be still worse. Having but few *wants*, and these easily satisfied, the native naturally sees no use in steady labor, and in the accumulation of stored resource against the struggle for existence, i.e. capital. He speedily reaches the point where extra exertion ceases to afford a return proportionate to the discomfort of the extra effort; and so he stops. Animal comfort for the moment and a little satisfaction of vanity are often his only objects; he lives from day to day, and lets the future take care of itself. Economic incitements to further achievement meet an immense and stolid inertia; the ceaseless and fevered activity of civilized peoples impresses the native as folly, for he cannot understand its motives if he would. Hence the only system under which the tropics in general have been drawn into the trade of the world has been that of supervision and direction by the more active races, with the object of stimulating production. How and with what success this has been accomplished we shall presently see.

The tropical "natives," left to their own initiative, have produced no commercial supply region of any importance; and they have afforded as little satisfaction to traders in constituting a region of demand for the products of civilization. The same circumscribed character of their wants which has limited their own production has determined the feebleness of their demand for the products of others.

They demand practically no food products from without, and only such materials for clothing and ornament as happen to catch their fancy. There is some call for improved tools, more for improved deadly weapons ; and there is usually a strong demand for intoxicants (§ 154). Europeans, with an eye to their own safety and for humanitarian reasons, have been unwilling to supply firearms and alcohol, and, as a result, the tropical demand region has been further restricted and its inhabitants further excluded from participation in the world's commerce.

Thus, left to themselves, the uncivilized peoples of the hot zones manifest but little disposition to emerge from their undeveloped state, or to react further upon environmental conditions, to which, as far as their comfort goes, they are satisfactorily enough adapted. If let alone, they continue to produce and exchange within restricted localities and on a small scale ; each little group is self-sufficient and indifferent to the life of others. Natives might have gone on in this way for centuries had it not been for the general irruption, commencing about the end of the fifteenth century, of the white man into the tropics. This constituted, in reality, the collision of two quite distinct civilizations with all their characteristic qualities. Our concern is, however, to determine the effect of this movement upon the redistribution of areas of civilization and so of commerce.

176. Slavery and emancipation. In their attempt to make use of their tropical possessions the invaders speedily found that they themselves were prevented from actual labor, even if they had wished to engage in it, by the impossibility of speedy acclimatization (cf. §§ 143-145). Several centuries have not materially altered this situation. If, now, the tropics were to be developed, — and this has been a premise little short of axiomatic, — then an acclimatized race must do it. The expedient nearest at hand for the accomplishment of this end was enslavement of the natives, which accordingly took place all but universally. To a certain degree this eventually placed the control of the natives' productivity in the hands of the whites, and the newly occupied regions took their place in the world-market. To a certain degree they responded under pressure to the world's demand. This forced production was sometimes extremely hard on the natives, who in many cases sank beneath the burdens of a system to which they were totally unfitted ; in other cases the mere obligation to labor seems to have done them good rather than harm. Abuses connected with the system of slavery, however, together with a growing distaste for it on the part of the nations of the cooler zones, led, between 1800 and 1870, to its general abolition.

The result of this move was to throw tropical production back upon the volition of the native, and it cannot be said that his centuries of forced labor had taught him to be much more industrious than before. The general result bearing upon the distribution of trade areas was something as follows: before the tropical planter lay several alternatives, namely, ruin; adoption of a new productive force (machinery, etc.); evasion of the prohibition of compulsory labor. Many producers lost everything; some struggled along with an irregular and intermittent labor supply under the wage system; a few could surmount the great difficulties of the introduction of machinery; a certain proportion managed somehow to evade the prohibition. As the demand for tropical products has increased with the development of civilization and trade, the pressure upon the tropical producers has become more insistent. In some few cases the natives have been induced, too often under incitement of their baser desires, to labor for wages. Alcohol, for example, has been supplied to some as the only effective inducement; some planters have actually preferred bibulous laborers, for, whereas the sober native can earn enough in a few weeks to meet all his needs for a year, the one addicted to drink quickly squanders his wages and then is led to resume his work after a shorter interval. And a great deal of evasion has likewise been practiced, some of it constituting direct infringement of law and some of it cloaked with more or less plausible justification.

177. Substitute labor supplies. Loss of labor supply was met, in some places, by a form of substitution called the coolie system. There are in India, and in Java and environs, certain tropically acclimatized tribes which are, by exception, fairly industrious; and to these should be added the Chinese, a people proverbially laborious and parsimonious, and seemingly able to endure all climates. To supply the loss of the slaves, large numbers of these coolies were imported by tropical planters under a system of contract and wages. At the expiration of their contracts they were to be restored to their native countries, unless they wished to renew their agreements or to settle in the foreign land. Great hopes were entertained as to the success of this substitution. However, there were unforeseen difficulties of a political and social nature; the presence of large numbers of coolies, together with the free and generally vagabond negroes, constituted a menace to the scattered whites, and many complaints were made of the immorality of the Asiatics. It was also asserted that the coolies were virtually enslaved, that the system was really an evasion of the laws against servitude, that contracts were violated, workmen intimidated, and so on. It was

on the score of these latter indictments that the system, rightly or wrongly, fell to pieces. Toward the end of the nineteenth century England and Holland, controlling India and Java, and China, which had always opposed the system, blocked the further export of coolies.¹

Charges of hypocritical dealing were made by other nations whose interests were thus assailed ; but the system of substitution came to an end notwithstanding. What the English and Dutch did with their own laborers we shall presently see. The situation was thus restored to its former state of dependence upon the local labor supply, with results as already described. Some peoples with tropical dependencies, notably the Germans, have taken recourse to a theoretic defense of "compulsory labor,"—a kind of slavery under a more palatable name,—which is probably widespread at the present time in certain parts of the earth. The theoretic defense is plausible enough and rests in good part upon scientific considerations. The contentions are (1) that the native has no right to pass his time in idleness while his betters are at work, and that the latter are not bound at their own inconvenience to leave him undisturbed ; (2) that it is a good thing for the native to have to labor, for labor and accumulation are the bases of civilization (this view assuming the self-evident value of what we call civilization) ; (3) that the only chance for native peoples is to fall in with the system of the predominant races, whether they will or not ; if they do not, nothing but decline and extinction lies before them, as the world fills up. As usual, the excellences of this system, easily developed on paper, fail to appear in the working out ; compulsory labor is, in practice, open to most of the objections urged against a regular system of slavery.

178. Race mixture. There is one more expedient for creating within the tropics a population capable of bringing these regions into full participation in world-commerce ; and that is, through the mixing of races. Certain French writers are theoretical champions of this expedient. Experience has demonstrated its futility, however, as a general policy. In the first place, it is extremely difficult, if not impossible, to maintain a mongrel race ; the predominance of the one or the other constituent element tends in time to cause reversion toward one or the other component type, thus reducing the situation to its original form. Again, the mongrel groups that have been produced in the tropics have failed to exhibit the expected excellences, though they have generally resisted the climate better than the pure whites.

¹ A somewhat analogous importation of Pacific islanders into Queensland was prohibited by act of Parliament in 1890 because it so closely resembled a regular slave trade.

This is particularly the case when the uniting races are far apart on the scale of civilization. Probably the best mongrels are those formed by such fusion as that of the Chinese with the natives of the Malay Archipelago, as, for instance, the Chinese *mestizos* of the Philippines. The mixture on the grand scale of Spanish and Indian blood in Central and South America cannot be said to have been a success in its results, if we judge by the past and present of the Spanish American republics. We do not reckon the mulattoes of this country as an important element of our national strength. It is often said that the cross-races combine the bad points of the two constituents and lack the good points of both ; this is doubtless too strong, but it is a fact that past experience affords little ground for believing that progress in the development of the tropics can be much furthered by the attempt to produce a mixed race.

179. Non-development of the tropics. It should also be stated that, even under a system of beneficent slavery, no development of the tropics at all comparable with that of the temperate zone was attained. The inefficiency of slave labor has been often described ; where the civilized man could work and reproduce his kind, i.e. in the temperate or cool zones, it could never compete with free labor. This is one of the chief reasons for the non-development of slavery in temperate regions, and for the growth there of an ethical sentiment which finally secured its universal abolition. The case is briefly this : the slave has no personal incentive ; of a consequence his labor is half-hearted and unintelligent, depending for its effectiveness upon constant supervision and incitement. Some races, notably the American, have refused to submit to slavery, at least to that of the "plantation" type ; the Indians preferred death to such servitude. The only race which has ever generally submitted to the system is the negro race. But even the most docile of the negroes, whose light-hearted, childlike characters, as well as their strong bodies and constitutions adapted to tropical conditions, seem to have marked them out as destined to serve their conquerors, never constituted a reliable, productive body at all able to equal the achievements of free white labor in the cooler regions. The very qualities which made them better slaves constituted antitheses to the disposition which animated the creators of the world's civilization and trade ; for the latter have been characterized by persistence, self-denial, foresight, and so on.

Thus, taking the tropics as a whole, they have not been and do not seem likely soon to be drawn into full participation in the world's civilization, and, more specifically, in its production and exchange. One

partial exception must, however, be noted. Some of the tropical races, as we have seen, were able to furnish a substitute labor supply to countries whose natives were, for reasons just mentioned, unavailable (§ 175). These peoples (chiefly from India and Java) stand upon a stage of civilization considerably in advance of that of other tropical peoples. This is manifested in part by a better developed system of government, or subordination to rules. The result of this subordination has been that the peoples in question have been for ages under a system of compulsory labor for their chiefs. For this and other reasons they have evolved a more laborious disposition than that of the other tropical peoples, more foresight, and a more developed desire for accumulation. To a certain degree, therefore, they form an exception to the generalization that tropical peoples will not voluntarily cooperate in the economic development of the tropics. Unquestionably, India has entered very genuinely into world-commerce. However, it seems likely that the effectiveness of the activity of such peoples has been exaggerated; indeed, one of the objections to the coolie system (§ 177) was that the results were not proportionate to the effort, expenditure, and political dangers involved. The generalization regarding the economic ineffectiveness of the tropical peoples, despite partial exceptions, still holds; there seems to be little hope at present of adequately developing these regions at the hands of the natives or of the whites.

One other present possibility, however, exists. It has been seen that some of the members of the other race of temperate regions — the Mongolian — adapt themselves with slight inconvenience to a variety of climates. The Chinese have made effective coolies and are now the best free-labor force applicable to the development of the hot regions. They have to a marked degree the qualities to be desired — laboriousness, frugality, foresight, etc. — and, at the same time, intelligence and a business sense. Where there exists an at all available native labor supply, these Asiatics are found to be the best of overseers, for they understand the condition of the native better and are not often physically incapacitated, as are the whites. The same may be said of the Japanese, although their activities along these lines have been much more restricted. Unfortunately for the economic present of the tropics, however, strong prejudice, partially justifiable and mainly not, has existed and still exists against the Chinese. They are hated, as the Jews have been hated, because of their successes; because of their oppression as money lenders, etc.; because they are clannish and have no "public spirit," wishing only to gather wealth and return home;

and because, as some have maintained, with, as it seems, but slight justification, they are, according to modern standards, highly immoral. With the discussion of these questions we have nothing to do; the actual status of the case is that few tropical countries are likely soon to be developed through Chinese labor. We therefore return again to our conviction that the tropics enter but slightly into the world-commerce, because they are as yet, and must long remain, regions of little or no civilization.

180. Types of the agents of trade. The general topic of the chapter having been, then, the distribution of the human race upon the basis of its civilization, we may distinguish, in a general way, several types; our prominent criteria are climatic environment and degree of isolation. The types are four in number, and are very uneven as respects numerical representation: (1) The type represented by those races of the temperate zone, which, by reason of favorable situation, have been enabled to develop, compare, borrow, and accumulate civilization; these are the inhabitants of western and southern Europe, of southern Canada and most of the United States, of Japan and of southern Australasia. (2) That more backward or undeveloped type represented by the inhabitants of isolated areas of temperate regions: eastern Europe; interior of Canada and Mexico; Alaska; China; southern Siberia; western Asia; southern Africa; southern Brazil; Argentina and environs, and Chile; interior of Australia. (3) The fairly productive tropical or subtropical type: northern Africa; West Indies; coast regions of Brazil; Polynesia; Malay Archipelago; India; Farther India. (4) The peoples of as yet unavailable regions of extreme heat and cold. The combinations of the above-mentioned criteria are as follows: in (1), favorable climate and non-isolation; in (2), favorable climate with isolation; in (3), unfavorable climate and modified isolation; in (4), unfavorable climate and extreme isolation. The element of isolation tends to pass away with the development of means of communication, while the climatic element is, so far as our knowledge goes, permanent; thus (2) tends to pass into (1) and disappear.

CHAPTER XI

NATURE OF TRADE. ITS ROUTES AND STATIONS

181. Specialization and coöperation. After having in preceding pages considered the influence of typical environmental conditions upon man and his civilization, we have been enabled roughly to indicate the geography of trade as determined by the human factor — by man, the producer, purveyor, and consumer. Returning now to the characteristic power of reaction upon environment shown by human societies (§§ 139–141), we wish to exhibit trade itself as a form of such reaction, that is, as an expedient in the struggle for existence and for higher standards of living.

If every person made entire provision for his own wants, there would be no reason for the existence of trade, as between individuals; if every limited group of men were similarly self-sufficient, there would be no reason for trade between groups; if nations and races wanted articles of local production only, there could be no international or world trade. The very existence of trade implies varieties of wants and varieties of want-supplying occupations, distributed in no strict correspondence with each other among individuals, groups, and peoples. That which leads to this lack of self-sufficiency in individuals or societies is an evolved economy of effort, as represented by division of labor or differentiation of function. In the case of individuals, all this means that each producer shall bring forth that which he can produce with the least pain and effort, or with the most satisfaction to himself; also, that through continued practice in the same occupation he may, as a result of experience and the concentration of attention, become progressively more expert in his occupation, that is, develop a better product at a constantly decreasing cost of material, energy, and time. If we all had to make our own shoes, clothing, hats, etc., we should, as we say, waste a great deal of time and force for, on the average, very poor results. Suppose A, B, C, and D made severally their own weapons, tools, clothing, and shelters. Let x be a unit of energy, and suppose each expends $25x$ a year in making weapons, and $25x$ each in making tools, clothing, and houses. The

total for each individual would be then $100x$. Now if each could choose one specialty and neglect the other three, in the course of events he would gain dexterity, skill, and experience. Perhaps $20x$ concentrated would suffice to do what $25x$ scattered had done. If so, and if one unit of each of the four classes of products could be exchanged on even terms for one unit of any of the others, the annual expenditure of energy per specializing person would be $80x$ instead of $100x$, and at the same time the quality of the product would steadily improve. The $20x$ saved might be used for a number of purposes, tending to increase present comfort or augment future power over nature. This represents a great advantage in the struggle for existence. The Jack-of-all-trades is an interesting rather than a useful member of society; Robinson Crusoe's outfit was picturesque in its setting, and well adapted to its purpose, considering the difficulties under which he is reported to have labored, but, as compared with the products of specialized and skilled industry, Crusoe's tools, clothing, and other possessions were extremely crude, and were produced at a great expenditure of time and energy.

The economy of effort secured by a division of labor may be, likewise, of the greatest importance to a group or society of men as well as to the individual. Suppose that A, B, C, and D constitute a group, and that each member supplies himself with food, clothing, shelter, and tools, spending an annual effort represented by y in the process. The total expenditure of the group would then be $4y$ a year. If, now, the several occupations were divided among the workers of the group, each would learn by practice and experience to perform his specialty with greater ease and skill; he would save effort represented, say, by z . The expenditure of effort for the group, then, would be reduced by $4z$. The greater the specialization and acquired skill, the greater would z become. Also, taking y to represent expenditure of time (instead of effort), the same result would emerge; instead of an original expenditure of $4y$ we should find a lowered one of $4y - 4z$. But the $4z$ of time or energy not absolutely required for creature-wants represents the possibility of leisure, reflection, invention, and a number of other factors of prime importance in the development of civilization. Such economy, being as distinct an advantage in the struggle for existence as the power to put forth more force, would speedily become an object of selection; or, looked at in another way, it would soon be discovered by the adaptive human mind, and put into operation (§§ 135, 139). The very lowest tribes of men, and even some of the animals, have long practiced it on a more or less reduced scale.

However, as must already have been noted, this result would be impracticable without the development of exchange of products between the specializing producers, either individual or collective — that is, of trade. Commerce stands, therefore, as an expedient in the struggle for existence, as a form of rational (or even unconscious) adaptation to the exigencies of physical environment. The skilled old arrow maker trades his flint points for the booty of the chase, and both he and the vigorous hunter gain advantage from the exchange, in the preservation of their lives and in the elevation of their standards of comfort. Naturally, however, it is not individual specialization and exchange between individuals that interest us in the present connection ; trade really worthy of the name comes out of group specialization and inter-group exchange.

182. Trade and war. The fact that the advantage of specialization and exchange is mutual early impressed itself upon the instincts or reason of men, and gradually brought into prominence the practice and ideal of coöperation, as between individuals and groups. But to bring about such a development took time and the enlistment of strong interests. The earliest mutual relations of men were more likely to be those of strife and war, their attitude that of mutual hostility and suspicion ; the first meeting of groups took place, not in the market, but on the battle field, or rather, on the hunting ground, for early man made a quarry and a meal of his slain fellow. It is instructive to note that early trade was so often an alternative to war, and that it retained many marks of its association with that ruder form of pursuing the struggle for existence which it gradually came to supersede.

In war, in a general way, one party gained what the other lost ; but, especially if the contestants were evenly matched, the losses of both were considerable, in men and in things. Instead of coöperating against nature in the struggle for life, group strained with group to wrest away any special advantage already secured in the form of organization and capital. War meant a general destruction of advantage in the struggle for existence, an annihilation of energy stored against the battle of life. Doubtless militarism taught discipline, the great lesson of human life, as nothing else did ; doubtless much that was developed for war-like ends came later to serve industrial development. But as compared with peaceful trade, war was undoubtedly wasteful and uneconomic, and made against the development of civilization. It was natural enough in the early ages when men knew no better, for of course one group was not willing to give its products in exchange for those of another when it could take the latter for nothing ; and for long ages

of the world the question whether war or trade should be put into operation in a given situation depended very largely upon the relative strength of the groups in question. Even the Phœnicians, when in force, pillaged and burned; if their prospective "customers" outnumbered them, they sought an almost equal advantage in peaceful, if tricky, trade (§§ 194, 195). For centuries, piracy and peaceful trade were two phases of the same general operation.¹ In fact, it has taken ages to drive home even a faint and halting realization of the fact that coöperation is more apt to man's situation on earth than a system of hostility and cross-purposes. In the Middle Ages it was widely believed that only one party to a bargain gained, though the practice of the actual trader completely negated the view. Economic systems of a much more modern age witness for the survival and periodic re-animation of the same belief; with trade restrictions and tariff wars abounding, it is still hard to persuade mankind of the superiority of coöperation over strife (§§ 207 ff.).

Several instances of early forms of trade may be adduced to show the intimate relationship in point of alternation between war and trade, between suspicious hostility and confidence and coöperation. Among certain African tribes, exchange is made with weapons poised, the parties approaching and returning from each other's presence in crouching posture — ready to pounce or to flee — and in the most suspicious frame of mind. The tendency, however, is plainly toward peace: there are in certain tribes professional exchangers, trained to the function from childhood, whose persons are inviolate in the midst of general hostility and violence; very often the women are the tribal specialists in trade. Further, out of centuries of strife over the possession of mines of native wealth, such as flint deposits or salt works, there develops the custom of "peaceful access" under some sort of recognition dues. Peace was maintained by the Indians in the sacred territories of the red pipestone. In primitive or partially developed societies, also, it is found that in the regions and during the periods of the holding of markets or fairs warfare is suspended and violence repressed; and so on. Perhaps the most significant evidence of the passing of violence and robbery into peaceful exchange is afforded by the so-called custom of "silent barter," "deposit barter," or "dumb trade," a custom found here and there over the earth up to the present day, but perhaps most clearly set forth in the earliest historical account of which we know, that of Herodotus (Book IV, 196). He tells how the Carthaginians used to trade with the natives of the northwest African coast, under conditions where the parties to the exchange apparently did not dare to come within striking distance of each other. The Carthaginians upon reaching the coast were accustomed to signalize their presence to the natives with columns of smoke. Meanwhile, their wares were disembarked upon the shore and they themselves returned to the ships. The natives, venturing down to the sea, examined the articles and placed beside them such of their own possessions as they were willing to give in exchange: then they

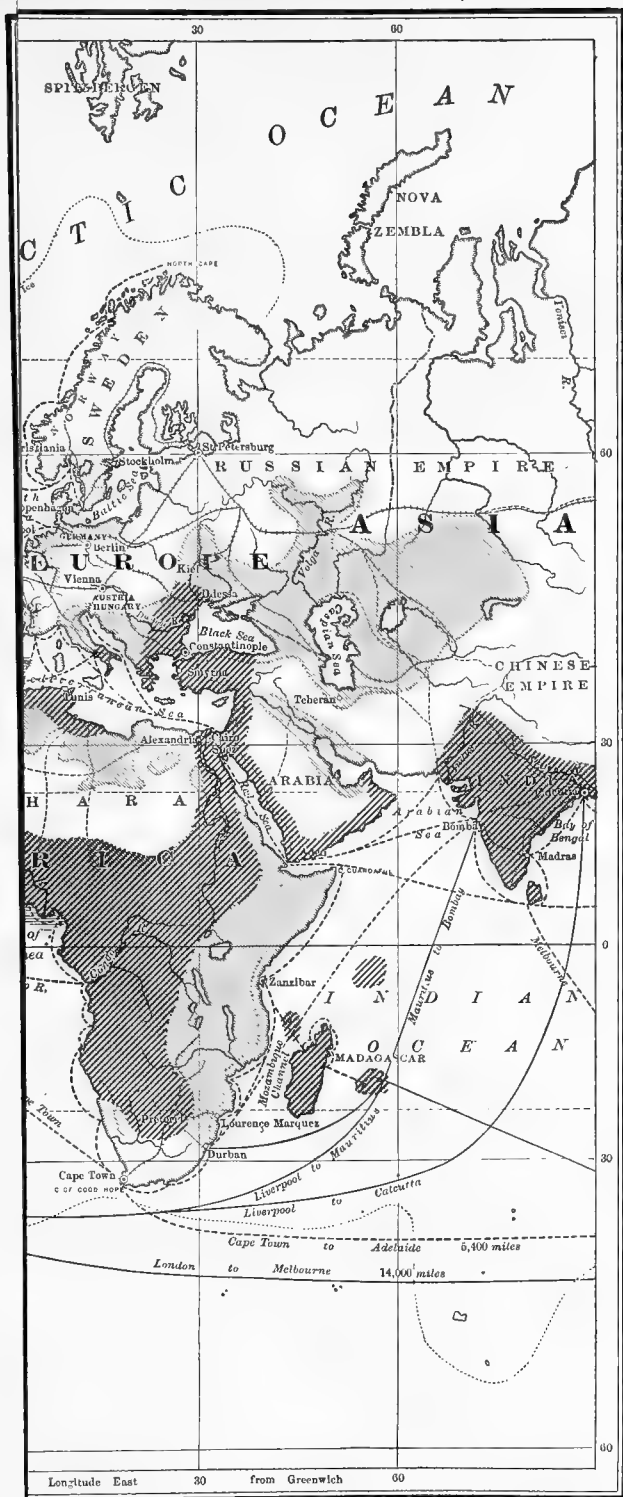
¹ "Krieg, Handel und Piraterie,
Dreieinig sind sie, nicht zu trennen."

Goethe, *Faust*, Part II, 6574-6575 (Schröder's edit.).

also retired. The traders, returning, either accepted the native goods, in which case they removed them to the ships and departed, or rejected the amount as insufficient by returning to the ships and awaiting further offers by the natives. The natives might then add to their deposit until the quantity and quality desired by the traders was reached, and the latter accepted the terms as above indicated. On reading this description for the first time a dual query rises in the mind: Why did not the parties to the trade actually meet and dicker? Why did neither party decamp with the other's goods? Evidently they did not meet and barter because they did not dare to do so; the long-distance system here developed is clearly an evidence of the suspicion and distrust engendered by an antecedent period of warfare and pillage. And neither party reverted to such methods because there was more to be gained by a series of peaceful exchanges than by one or two violent robberies, followed by a cessation of intercourse. Here again is emphasized the economy, in the long run, of trade over force; thus is coöperation through exchange demonstrated to be an expedient apter than violence in the struggle for existence.

The whole history of man has served to bring out more and more clearly the fundamental antagonism between trade and war; that violent methods are employed, usually mistakenly and shortsightedly, to secure trade does not affect this antagonism. Martial law, the cessation of guaranties, and general insecurity are a blight to the life of commerce, and are so recognized except in cases regarded as special. The very rise in the rates of marine insurance for ships intending to approach a focus of hostile operation is sufficient evidence of this fact. If, now, war and its weapons and system represent an intellectual adaptation of man in the struggle for existence, trade, succeeding war, must have been found a better and more economic expedient in the same conflict. What trade has done for the development of the race we shall try later to show; for our present purpose it is enough to have indicated the origin of exchange as a form of specifically human adaptation through the activity of the mind, this being, as has been seen, a sort of corollary to the economy adaptation secured by a division of occupation (§ 181).

183. The ways of trade. We have seen how different types of natural environment have called forth in varying degrees the responsive, adaptive powers of man. Commerce, being one of his expedients in the struggle for existence, would thus be conditioned in its forms and determined in its ways by the different types of natural environment to which men are subjected. This might be called the direct dependence of commerce upon natural conditions, a topic which has already been touched upon above (§§ 172 ff.). It goes without saying



that the materials of commerce of any district are determined by the geologic, physiographic, and other natural conditions of the district. Coal cannot be mined in the coral rocks of Bermuda, nor can palms thrive in Antarctica. Furs are not a prominent import of the Congo region, and tapa cloth would profit the Eskimo but little. In this section, however, we wish to fix our attention rather upon the determining influence exercised by various conditions of the natural environment upon the location of the ways of trade.

Man, as we have seen, works constantly along what he conceives to be lines of least resistance ; it is thus that trade routes are determined. Before man had learned to react strongly on nature, the routes of his transportation represented roughly his skill in selecting the easy and avoiding the difficult, as these were given in nature (§§ 291, 292). Thus the earliest ways of trade were around natural obstacles and were often devious in the extreme : in the desert they lay between oasis and oasis ; on the steppe, from one source of water supply to the next ; in the forest, through the less dense growth. They wound about the foot of the mountain, met the river at the fords, avoided the swamp (§ 292), sought the continuous ridge or the level, and so on. Reacting at length against obstacles, men hewed a tunnel through the jungle or a narrow trench through the savanna grass, blazed the trees of the forest, threw slight bridges across streams and ravines, and otherwise expended an overplus of present effort to secure a way of less resistance for some time to come. In particular, man discovered the saving of friction and the gain of motive force to be attained by utilizing water ways, wind currents, and other favoring elements in nature (§§ 169, 189, 194). To pursue a roundabout course with the streams or winds was preferable to the tracing of a direct course in their absence. Each of the betterments of roads and vehicles previously referred to (§ 164) meant the striking out of a new line of an average least resistance.

184. Continental routes. It will be advantageous to consider land routes — and for convenience they may be taken to include internal water routes over rivers or lakes — by themselves ; ocean routes were of a much later development, and introduce considerations of a wider nature. In the review of ancient land routes we may exclude America from our consideration ; although pre-Columbian commerce was stronger than was once thought, the shells, pipestone, and other desirable articles, which not seldom passed halfway across the continent, were handed on informally from tribe to tribe rather than floated upon a steady stream of trade. Again, the exchange accomplished between the Indians and the Eskimo was scarcely of an importance significant

to our purpose. The internal exchange of the Mexican and Peruvian empires was already a mature and developed system, capable, perhaps, of being set alongside that of a civilized European state ; but it is prime evidence of the essentially restricted communications in pre-Columbian America that these two empires were ignorant of each other's existence. For our present purpose early America presents nothing that will repay description. Australia, Africa south of the Sahara, northern Asia, — in short, all the outlying parts of the world, — may be similarly neglected in a study of the land ways of trade. The center of interest of this topic lies in the region containing the antique foci of civilization, for it was from there alone that trade routes worthy of the name, or likely to repay study, radiated. In other words, the early development of trade on any considerable scale, as an expedient of men and societies in the struggle for existence and for a higher standard of living, is found in the north temperate zone of the Old World, — the region to which so many of our lines of development lead back (cf. §§ 148, 159, 160, 166, 194), — whence in later ages it overflowed toward the south and then penetrated into the remotest corners of the earth. For the determination of the routes of this commerce we may rely on something more than inference, for we are already within the field of history ; and in confining our remarks to these ways of trade we introduce no essential limitation, for they were perfectly typical.

The natural internal routes of the Chinese trade were the rivers ; and the same may be said of India, Persia, and Egypt. To the era of trade during which it was confined chiefly to limited areas the term " potamic " has been aptly given (§§ 166, 187, 188). But rivers are not always present where trade is impelled to go, and so in all these countries there is found a considerable purely land traffic. The Chinese early pushed westward across deserts and plateaus, carrying their trading operations as far as Persia ; they also pursued land routes into Mongolia, Indo-China, and other regions. The Assyrians were more passive, but the Egyptians penetrated the desert to various oases, and their connections with " Ethiopia " (Nubia, northern Abyssinia, and possibly Kordofan) go back probably to 2000 B.C. Again, it is clear that a caravan trade passed between Assyria and Egypt in remote times, although this was prevailing in the hands of an intermediate people — the Phœnicians.

Such early evidence is bound to be vague and uncertain ; in order to get a useful perspective of land routes it is necessary to come down to a time when they had become more definitely fixed over wider areas, and thus lend themselves more readily to our form of examination.

At the same time, to get simple examples of what might be called "natural" routes one must needs go back far enough into the past to antedate man's activity in the wholesale modification of natural conditions to suit his own purposes. The period at which the latter process is generally considered to have begun in irresistible force is that ushered in by the Renaissance, the Reformation, the discovery of the sea route to India and of the New World. We take our first examples of land routes, then, from the mediæval period. The great desideratum of this age was the connection through trade of the Orient and the Occident, or, more directly, of the Orient and the Levant; and the earliest connections, later reverted to in time of stress, were overland. These routes are indicated in a rough way on an accompanying map (Plate I); detailed study of their courses in relation to topographic features reveal the obvious reasons in physical nature for the particular trends which they pursue.

These were not, of course, the only land routes of the period; they were rather what might be called the "trunk lines" of contemporary commerce. The subsidiary lines which were used in the distribution of eastern products in the west are also of deep interest to our subject. Between the Levant terminals of the overland ways and the sources of European distribution there intervened a mediterranean route of which we shall presently speak. In general, however, these sources of European distribution may be taken to be: Venice above all; then Genoa, Marseilles, Barcelona, London, Bruges, Antwerp — all via the Mediterranean and Atlantic — and Odessa and Kaffa via the Black Sea. The penetration from these bases of supplies was largely by way of the rivers: the Volga has through ages constituted a trade road to the famous old market of Nizhni-Novgorod; the Danube to its particular back-country; the Rhone, Rhine, and other west European rivers to the not remote interior. And from the Italian cities land routes penetrated northward over the old Roman military highways, skirting the mountains, slipping through the passes, and finally emerging into the heart of the interior of west-central Europe.

Looking at these routes of interior trade in a broad way, the contention of Ratzel (*Anth.*, II, 467) becomes plain, viz., that trade routes are not mathematical lines but wide bands, and that their terminals are not points but regions. Naturally the "trade-route belt" must also be the "city belt," for the growth of cities is directly and inevitably dependent upon the importation of much food and other articles. That the general extension of the clusters of trade ways is latitudinal rather than longitudinal is again due largely to the concentration of the world's energetic population, through all later ages, in the north temperate regions (§§ 148, 198; cf. fig. 22). Unless the tropics can be developed to a far greater degree

(§ 179), this condition must long persist. And, finally, let it be noted, in anticipation of later discussion (§§ 201-204), that the ways of communication represent one of the most vital factors in the spread of civilization.

185. Improvement of routes and roads. Now, as it is our object constantly to recall the reaction of man upon nature, it is in place to consider the courses of land routes as modified by modern engineering and other methods. This modification will be found to represent new ways of securing the old object, i.e. decreased resistance or cost. Consequently, the qualities aimed at in the modification of nature's roads will be levelness, homogeneity, smoothness, directness, and so on. The modification of road and vehicle toward one another has already been the object of comment (§ 164); let us now briefly compare the lay-out, with respect to natural obstacles, of the modern overland trade routes as compared with earlier forms.

It has been seen (§§ 163, 184) how the early highways tended to take advantage of the absence of natural obstacles; how they tended, if not to take to the rivers, at least to follow their valleys. In time, however, the highways came to be laid out with less reference to favorable conditions as found in nature (§ 294), and engineers became bold enough to cope with nature's minor hindrances successfully. That the early railways in general followed the highways seems clear enough; but the startling growth of man's power over natural obstacles is shown by their tendency to break away from the former leading-strings. The growing demands of complex modern life and the augmenting importance of the time element have had their effect; millions are spent in eliminating even slight curves of the road-bed—in cutting, filling, tunneling, and bridging. All this results in a considerable departure from old ways of trade. Hence the railroad may operate to neutralize natural disadvantages; it may better the situation of a settlement, summon it to a renewed life, or even call into existence new centers of population. Illustrations of the artificial alteration of natural conditions connected with the construction of railroads are numerous.

A great deal has also been done toward ameliorating internal water communication; river channels have been cleared and straightened; the water roads like the land routes have been rendered freer of obstacles. Artificial rivers (canals) have been constructed (§§ 295, 296), and their courses leveled and their currents quieted by means of locks and other devices. Lake navigation has been similarly benefited. For many decades it was believed that internal water routes would never meet severe competition from land routes (§ 296), despite their relative indirectness and the slowness of their passage.

It must be understood, however, that even with the growth of man's "power over nature," its limits are set, and by forces beyond control. The physically impossible may scarcely exist in the eyes of engineers, even though certain obstacles could never be overcome; but the physically difficult may easily become the commercially impossible, that is, the new line may not after all be one of "least resistance." One of the roads which enter Pittsburg spent over \$35,000,000 in overcoming a minor geographical obstacle. In building the Canadian Pacific, in one case a shelf along the coast, 20 feet wide and 11 miles long, had to be blasted through rock; one single mile of the road cost \$750,000. Many small rivers were diverted from their natural courses—one a stream 150 yards wide—through rock tunnels. In the sixty-two miles from the summit of the Rocky Mountains to the valley of the Columbia River, the Kicking Horse River, which the line follows, falls 2778 feet; this stream had to be crossed nine times, and there were 370,000 cubic feet of rock to be removed, besides the tunneling work. These tremendous costs in labor and capital represent the resistive power of environment; it is plain that men would never undergo them if there were any available way of escape. From what has been said it is clear enough that, despite such *tours de force*, the modern ways of overland trade are still largely and directly conditioned by the character of the physical environment.

186. Water routes. The reason why commerce has taken to the water where possible is sufficiently obvious (§ 169); the river ways are seen to have formed a great factor in what may be called interior or continental trade routes. In fact, it is only with the invention of the most perfect roads and vehicles that land transportation has been able to compete at all with that by water. The construction of canals and their persistence in the presence of railroads is evidence enough of this assertion (§ 296). In approaching now the topic of water transportation and sea routes the subject may be divided into two sections: mediterranean (inclosed-sea) routes and ocean routes. Or, to use another nomenclature, we may trace commerce from its "potamic" (or interior) stage into the "thalassic" and then the "oceanic" stages.

187. Commerce of the mediterranean type. The thalassic stage is most completely represented by the case of the Mediterranean, though to a less degree by the East and South Asian seas, some parts of the Pacific archipelagoes, and the North and Baltic seas. It can hardly be maintained that the Americans developed into this stage; and the Africans and Australians scarcely took to salt water at all. We know most about the Mediterranean traffic, for it is the lineal prototype of

the European world-trade itself. The way in which the navigation of such a large body of water was begun was by very slow and timid stages (§ 194). The peoples of the eastern end of the Mediterranean were, as neighbors of the ancient empires, the first to attempt this hazardous undertaking. The Phoenicians or their predecessors first put to sea in very inadequate vessels, and dared not advance far from the coast in their occupation of fishing. They were favored, as has been seen, by the exceptionally opportune character of the coast line and island groupings of their vicinity (cf. §§ 168–170). The first "routes" hugged the shores and proceeded by slight stages from indentation to indentation, or ventured from island to island across narrow sea arms. What would now be a slight menace of sea or weather sent the venturers scuttling into harbors where their frail craft were beached and drawn up beyond the surf. Adverse winds effectually destroyed their slight headway, and night sailing was out of the question.

Because, however, of the favorable conditions under which they worked, the fishermen traders had at a very early period gradually ventured throughout the *Ægean* and penetrated the Black Sea. Thus far they scarcely needed to pass out of sight of land, and, though certain channels and ways had been favored, because they presented fewer difficulties to the crude seamanship of the age, no distinctly marked highways of traffic can be laid down. When, however, the southern extremity of Greece had been reached, distances began to be greater, and to call for the employment of all the resources and courage hitherto accumulated. These had grown to meet the opening situation, and the wider areas were successfully crossed; the mariners crept up the western shore of Greece and then dared to sail for southern Italy. Gaining confidence along with skill in the navigation of improved craft, they then passed onward to the western end of the Mediterranean. They crossed from Sicily to North Africa and thence proceeded along the coasts of what are now Algeria and Morocco. They even pressed on beyond the so-called Pillars of Hercules (Strait of Gibraltar), and skirted the western shores of Europe to England and to the Baltic, and those of Africa a shorter distance southward. It is to be noted that the earliest Mediterranean routes followed the broken northern shore of the sea and let the unbroken southern shore severely alone. The story of the *Æneid* tells of the fear in which the ancients held these sandy coasts and their perilous waters. The country now known as Tripoli received but little attention for some centuries, i.e. until the spread of the Greeks (§ 196).

Here, then, lay the devious pathway of early trade and settlement, determined almost wholly by obvious physical conditions. The trepidation of the ancient mariners in the face of relatively minor dangers is clearly exhibited in the story of the *Odyssey*. Both Odysseus and Menelaus came to grief in doubling Cape Maleia, and the former's wanderings are one long nightmare of sea perils (cf. § 195). Noteworthy, however, is the constantly augmenting power of man in adapting himself to the situation, through the perfecting of his vessels and seamanship. Before the West was reached the art of steering by the stars—first by a constellation, then by the North Star—had been acquired, and the vessels had attained a type of model and equipment which permitted of greater speed and resistance, and made possible the riding out of a storm or even tacking into the wind.

The later trade routes through the Mediterranean are but refinements upon these natural first ones. This or that precaution was neglected or rendered unnecessary, ways became more direct and came to be determined to a larger extent by markets than by physical features of land and sea. In the classical times the isthmus of Corinth was crossed by transshipped cargoes or even by whole ships drawn upon trucks, and so the long voyage around the Peloponnesus was avoided. The map (Plate I) indicates the general trend of the trade routes of this age. In the later Middle Ages still further modifications were made upon the original network of routes, tending toward decreased cost and danger, increased speed and efficiency, etc., until the final stage of thalassic navigation is represented by the several routes of the Venetians and Genoese and their competitors.

Similar developments took place upon other inclosed seas or along relatively favorable littoral. Any subsidiary foci of this nature were located, naturally enough, in the region of the ancient civilizations or on their borders. The relatively local and small-scale commerce of the Polynesians, though of curious interest, has not entered in any significant degree into the stream of the world-trade. The Chinese, in resistance to, or in evasion of the imperial orders prohibiting sea traffic, were early led by the circumstances of their position to develop trade relations with neighboring islanders such as those of Formosa, Japan, and the Philippines. These relations became extended in time to the south, and at length reached Borneo and penetrated the Archipelago. The determining effects of the winds upon the movement of this trade were very marked (cf. §§ 103, 124); commonly the Chinese sailed southward with the north monsoon and there awaited the veering of the wind to the south before their return; the interval was

necessarily employed in agricultural and other gainful occupations, and this led to settlement and to the establishment of more enduring trade ways and terminals. The Chinese coast trade penetrated in time as far as India, and for many generations connected with the western traffic of Arab and European at Singapore. Thus the trade which was nurtured up in widely separated mediterraneans finally met and contested for superiority. A somewhat less important commercial development took place at the hands of the Arabs, which, reënforced by the religious proselytism of Islam, placed a distinct stamp upon the civilization of northeast Africa (fig. 20) and the Malay Archipelago. Before the time of the Portuguese the Arabs formed an indispensable link in the sea traffic between the Italian cities and the Far East, controlling the Red Sea and Persian Gulf routes and most of the trade of the Indian peninsula. The first preoccupation of the earliest Portuguese viceroys and governors was the destruction of the Moslem sea power and the expulsion of the Arabs from the eastern seas which they dominated. In this endeavor they and their successors were thoroughly successful,¹ and thus this inferior focus of trade development was absorbed into the larger stream from the more favored source. The type of commerce which was developed in the Mediterranean thus gradually came to be the world type because of its power as a system in competition with its rivals.

188. Commerce of the oceanic type. But we have anticipated to some degree the discussion of the type called "oceanic." The ocean was ventured upon in very remote times not only by the Phœnicians, Northmen, and others in the West, but by the Malays and Polynesians of the East, and the Arabs in the Indian Ocean. No doubt the coast traffic along the Bay of Biscay equaled or surpassed in danger much of that which is more distinctly oceanic; but of true and systematic oceanic navigation, i.e. the utilization of the *open* ocean, there was none until the Age of the Discoveries. It can hardly be said that the Portuguese used the open ocean before the voyage of Da Gama; for we find exhibited in the new field the same timidity with which we have become familiar in the case of the Phœnicians. The voyagers crept along the shore rather than sailed the sea. It was only with further development, — with the acquisition of the compass and of skill in charting, with the invention of a sextant which could be operated on board ship, the learning of the southern constellations, and the advance in the creation of an "oceanic" type of vessel able to weather the new and more perilous conditions of ocean navigation

¹ Keller, Colonization, Chap. III.

for which the Venetian galley and caravel were entirely unfitted,—that navigation dared at length to strike out across entrant angles of the coasts and finally to pursue more advantageous routes directly across wide stretches of open ocean.

189. Ocean navigation. The early Portuguese captains crept along the northwest coast of Africa, fearing each headland or shoal which forced them to draw away from the land. They somehow worked through the region of calms (§ 102), paying heavily in time and in lives for each few miles of advance. There was no selection of the sea way, no avoidance of the as yet uncharted regions of calm, no advantage taken of the as yet undetermined courses of the winds. It was a local "Christian" pilot who finally, in 1498, steered Da Gama straight across the open sea from Malindi (near Mombasa) to Calicut; and it was many years before the sailors dared to pass to the east of Madagascar. In the course of time, however, greater familiarity with the Atlantic had led the seamen to take ever more extended advantage of the trade winds, with the strange result that Cabral, in 1500, trending exceptionally far to the westward (under the influence of a storm or an equatorial current), discovered, as it were by accident, the coast of Brazil. Little by little the paths of the winds were learned and charted, until in the course of generations the present sailing route to the East was adopted.¹ The history of the Portuguese in India chronicles many a situation whose outcome turned upon the presence or absence of ships whose arrival or non-arrival was a matter of the location, direction, or strength of the monsoon. Winds and tempests, calms, surfs, currents and countercurrents, shoals and reefs—these form the favorable or unfavorable factors of the sea way as do hills and valleys, swamps and rivers those of land ways. Coming down to more modern times, it is clear enough why voyages across the ocean are made as far north or south as possible; it is now understood that they are thereby shortened. Again, it was Franklin who first correctly demonstrated that the opinion, commonly accepted and acted upon, that it was "downhill to England" had a scientific basis (cf. § 19). It is a well-known fact that ships sail from England to Australia via the Cape of Good Hope, but return by doubling Cape Horn.² This is a

¹ See maps, Plate II, and fig. 21.

² "The use of currents of wind and water is, of course, much more important to sailing ships than to steamers. For instance, a clipper leaving a British port for Australasia at first hugs the European coast, in order to get the full advantage of the N. E. Trades; but south of the Equator she hugs the American coast, in order to avoid the S. E. Trades, and holds on southward till she reaches the latitude of the 'Roaring Forties.' Then before the 'Brave West Winds' she holds due east past the Cape

matter of the winds. In order to exhibit still more clearly the effect of natural conditions in determining sea routes, the following quotation¹ is given *in extenso* :

"The sailing routes of the Atlantic illustrate in a striking manner the effects of the prevailing winds. Between the Northern States and the English Channel the sailing vessel goes before the westerly wind and follows closely upon the steamer route. Returning there are two routes, a southern and a northern. The northern faces the west wind and involves much tacking back and forth. The southern route, going southwest to avoid the westerly winds, gets into the trades, passes along the coast of Spain, south of the Azores and Bermudas, and crossing in the latitude of Havana comes up northwestwardly to the middle Atlantic States. If the destination is the Gulf of Mexico, the recommended track is still farther south, passing into the Caribbean near Barbados and out through the Yucatan Channel into the Gulf. In the winter this southern route is made even longer, because the vessel must go farther south to reach the trade winds. Even the vessel bound for New York may then go 150 to 200 miles south of the tropic of Cancer. At this season the seas east and northeast of Newfoundland are more favorable to ships because free from ice. The icebergs and ice floes are released from their frozen moorings by the summer thawing and float about the ocean during summer and autumn. The solid freezing of winter holds the next ice crop in place until the succeeding June. During this season vessels returning from north Europe are recommended to follow the northern route. From the North Sea they go around Scotland; those from the Channel steer northwest from the Scilly Isles or south-western Ireland, till latitude 54 deg. is reached, then from mid-ocean a south-westerly route is followed along the coasts of Newfoundland and Nova Scotia. This northern detour is taken to avoid the strong head-winds and storms which often rage during this season with great fury between 45 and 50 deg. north."

It may be objected that sailing routes have but little to do with modern conditions and that discussion of them is of academic rather than practical interest. This is largely true; but it must be realized that something over one eighth of the world's tonnage still remains under sail.² Where speed is no consideration, i.e. in the transportation

of Good Hope. On the return journey, all this is reversed. Holding still *eastward*, she makes Cape Horn, and keeps on her course till she is near enough to the African coast to get the full advantage of the S. E. Trades; but north of the Equator she hugs the American coast, in order to avoid the N. E. Trades and to take full advantage of the S. W. Anti-trades. . . . Even steamers, however, are affected by currents and winds, especially by regular winds such as the N. E. Trades in the North Atlantic, or the 'Brave West Winds' of the 'Roaring Forties' in the South Atlantic and South Pacific. It is due to the latter, for instance, that the outward route to New Zealand, even for steamers, is round the Cape of Good Hope, while the homeward route is round Cape Horn" (Lyde, *Comm. Geog.*, pp. 45, 46).

¹ From J. R. Smith, *The Ocean Carrier*, pp. 59 ff. This author's chapter on Leading Routes of Ocean Commerce contains matter of great value for the class-room development of the present topic.

² The ships of certain peoples, e.g. the Chinese, are, of course, almost exclusively wind-driven.

of bulky, imperishable articles, steam power has excluded that of wind much less rapidly and thoroughly. And it will likewise be noted that steamers are not exempt from the influence of the natural factors already alluded to, and others; indeed they are more helpless in many ways than sailing craft because their motive force is not furnished free by nature. A glance at the steamer routes (fig. 21) of the present day will reveal the marked influence of a number of the factors just mentioned; parallelisms with and divergencies from the sailing routes are significant in many ways.¹

190. Improvement of navigation conditions. Certain physical factors have been pointed out which are about as determinative of water routes as are hills, rivers, and the like of land routes. But, as has already been seen, man, in his attempt to reduce future effort and cost by a large present expenditure of the same, has shortened and smoothed the land roads. Something of the same nature has been accomplished as to the sea ways, though not nearly so effectively. Ships still avoid obstacles rather than oppose or override them; in this they are aided, however, in many cases. It need not be more than pointed out that lighthouses, correct chartings and soundings, weather service, storm signals, buoys, wireless telegraphy, and the like are all apparatus for the protection of shipping against the forces of nature. Thirty years ago the average length of voyages by sail from the Lizard to Valparaiso was 102 days; in 1872 it was 83 days. And there is developed through the activity of the human mind something even better than mere assistance in evasion. At a pinch the cost of smoothing the wave surfaces with oil (cf. § 10) becomes an economy and is practiced. Again, the worst of obstacles in frequented places are sometimes removed; dredging operations and the dynamiting of dangerous reefs furnish examples of this activity. A great land mass is cut through and turned from an isthmus into a strait (§ 297) for the purpose of shortening a sea route and thus rendering it safer and cheaper. The saving of time in the round trip of a sailing vessel from New York to San Francisco through a Panama canal is estimated to be 111 days. Naturally very little can be done to neutralize the great forces of sea and air, but the water vehicle can be modified toward resistance. And finally the course of commerce can be secured by the distribution of losses through marine insurance.

191. Terminals and way stations. That the terminals and way stations of sea roads are of wide importance to the subject in hand

¹ See note 2, p. 205. This topic is capable of considerable elaboration, both geographical and historical.

may be inferred from the foregoing. We have dwelt in a former chapter upon the different styles of harbor (§§ 20 ff.); in the early stages of sea-borne traffic, however, it must be understood that all other considerations (of depth, size, etc.) yielded before those of safety to craft of small resistive power. The mouth of a small river was far preferable to such an open roadstead as, for instance, that of New York; and artificial harbors were unknown. The criteria of a good harbor have thus altered with the progress of naval architecture and the science of navigation. The decline of the smaller harbors of the New England coast (New Haven, New London, Stonington) is witness to the rapidity of development within the last century or so. For the present stage of oceanic commerce the qualities desired in a harbor are rather depth, space, directness of approach, and the like. The best modern harbors are of the flooded-valley or river types described in a previous chapter (§§ 27-32). It is to be noted that there remain but few strictly natural harbors; man has made alterations and improvements in them all. He has imitated nature's products and also her processes; by means of skillfully constructed walls and other devices he sets the sea currents and tides to washing out their beds where he wills, if he does not will too ambitiously.

There is another condition which must be introduced into the consideration of present-day sea terminals, and that is, the nature of the back country and the consequent distribution of land routes. The ways of trade now stretch across both sea and land, and there are few true terminals; land and water routes combine into one composite. A promising economic development of any region, which thus demands a sea outlet, is sufficient almost to create its own harbor entrance. If the cost of artificial breakwaters, etc., seems likely to be repaid either through the development of traffic or through its diversion from larger and more costly land routes to more distant ports, the construction of such harborage constitutes ultimately a line of less resistance (cf. § 33). Again, the physically difficult becomes the commercially possible; but these cases are rare. All that has been said of the safeguarding or improvement of water routes applies with double force to the harbors, for it is here that the concentration of traffic repays the immensity of the cost. There is a limit, however, here as elsewhere, to man's power over natural conditions. Many a stretch of shore has no commercially possible harbor because the construction of such would be physically too difficult. The United States government has sunk millions in the hopeless attempt to improve a certain class of rivers and harbors whose only claim to attention has been a political

one. All the money and the efforts directed toward the diversion of trade from New York to Philadelphia or Boston have been in vain; the stream of trade, as is admitted, "naturally" flows over New York because of the manifold natural advantages possessed by that port.¹ That, with the increasing complexity of commerce, more and more financial and other factors contribute to this result goes without the saying. The presence, however, of these very advantages is to be referred in no small degree to the favoring influences of natural conditions, acting either now or in the past. A consideration of the maps of trade routes (fig. 21, and Plates I and II; cf. § 34) will exhibit a perspective of the harbor factor in modern trade.

Of the way stations of commerce it may be said that their character too has changed considerably with the evolution of commerce into more complex forms. The early way stations were, strictly speaking, few, for the commerce of ancient times was largely of the peddling variety, and almost every stop was a prospective market. In earlier centuries it was very necessary to have places where vessels could be careened and cleaned or repaired, where a deposit of materials for such purposes could be made, and where provisions and water could be taken on. Nations sought to have such halfway houses; for such purposes the Portuguese used Tristan da Cunha; the Dutch, Table Bay; the French, Mauritius and Réunion; the British, St. Helena. The most famous of such way stations was perhaps that at the southern tip of Africa; it is significant that the Cape Town district since its discovery has always belonged to the dominant European maritime power. St. Thomas in the West Indies forms an illustration of the way station that has lost its importance: during the earlier days of naval construction its protected harbor formed an ideal refuge for ships of all nations, to say nothing of giving convenient concealment to those of the buccaneers; but when ships became stronger, of greater speed and provision-carrying capacity, — when they had acquired, so to speak, a "longer wind," — the advantages possessed by this harbor declined. The vessels passed directly to their destinations. It is not impossible that it may again gain some perhaps unforeseen commercial importance as a result of the opening of the Panama Canal.

The advance of the naval art has, in another important respect, altered the status of the former way station. Steamers, especially the fuel-consuming war vessels, have become in a way far more dependent upon supply stations than the old sailing craft, for if the latter needed overhauls and food for the crew, the former require much more in

¹ For a sketch of the growth of New York, see Ratzel, *Anth.*, II, 471.

the line of skilled repairing and food for the engines. Of a consequence the various aspirants for maritime power feel the necessity of acquiring coaling and cable stations wherever their policy (generally a world-wide one) leads or is likely to direct their interests. They naturally select the old way stations for this purpose, and thus, in some degree, revive their waning importance. For example, France has coaling stations on the Comoro Islands and here and there in Oceania; Germany in the recently purchased or leased Carolines and Kiao Chou; the United States in Key West, Puerto Rico, Hawaii, Guam, and Manila; Great Britain in Malta, Aden, Zanzibar, Singapore, Hongkong, Wei-he-wei, Vancouver, the Bahamas, and elsewhere over the globe. Not all of the stations were old halting or resting places of the fleets of previous centuries, but all might be called way stations of commerce if the navies are its protectors. Naturally enough, the more direct routes of steamers have reduced the importance of stations that lay upon the more circuitous sailing routes, e.g. those of West Africa.

It should be noted that harbor-cities, by virtue of their trade, and of their mixed and varied population, are not seldom the gates of entrance for disease, especially for new and strange ailments. Yellow fever came first to Rio de Janeiro and Havana along with the slave-cargoes. A rigorous quarantine sometimes fails to exclude the germs of small-pox, cholera, bubonic plague, etc. In general, sea-ports are likely to show a higher morbidity and mortality than inland cities.¹

192. Nature of man's manipulations. In conformity with our method of presentation, the question would now arise as to what man can do to better the routes of trade over land and water; but, for the sake of convenience, this consideration has been touched upon as the account proceeded. It is only necessary now to recall the fact that all the expedients developed show man to be an adapter to natural conditions (§ 139), and not at all the master of them. Marine insurance, in particular, however clever a device, cannot be regarded as representing any important "scoring against nature." It is in reality merely an easier way of bearing through coöperation the regular vicissitudes of life; misfortune, a variable quantity, is reduced to a constant small element of loss, all damage being thus distributed among a large body of insured. If men ever get to use the air as a path for trade, it will be through a still greater cleverness than that already exhibited on the water, in detecting natural laws and conditions and adapting themselves to them.

¹ Cf. Ratzel, *Anth.*, I, 244.

It is nevertheless interesting to imagine a "historic landscape" in contrast to a natural one.¹ If a man could have viewed the central part of North America from above, say, in the pre-Columbian times, he would have seen an essentially natural landscape; something the same impression can be gained from a physical or relief map. If the United States could be so viewed now, the face of nature would be seen to have been altered. Deforestation would very likely have brought about the most striking change; but the country would also be seen to be "spotted" with human settlements, and interlaced with human ways. A map of commercial routes might here supply the perspective. Nevertheless the historic landscape could never be more than a veneer over the natural one, a fact which the non-indication of relief on our popular maps is calculated to obscure, at least in the popular mind. These superficialities are naturally sufficient to fill the horizon of human life, which deals so largely with the obvious and the proximate; the function of science in such a "practical field" is to introduce the wider and more fundamental — in the non-metaphysical sense, the more philosophical — conceptions.

¹ Cf. Ratzel, *Anth.*, II, 180.

CHAPTER XII

ANTECEDENTS OF MODERN TRADE

193. Race character in commerce. The last chapter has dwelt upon the immediate control of trade through natural conditions ; the character of our treatment now calls for a consideration as to whether commerce is not also indirectly affected by these conditions through their influence upon men, the agents of trade. If the practical merchant were asked offhand what determines the type and localization of trade, he would probably answer at once that it was the character of the people. Race character would so patently explain so many things about exchange that he would probably be disinclined to go behind it ; and in this he would doubtless be justified, for race character seems now so fixed and so sustainable in the face of an environment with which intellectual adaptation has secured at least apparent harmony, that it has taken on the character of an independent factor. Except through the broadest generalizations race character is practically inexplicable, whether it be exhibited in the emotional or the practical, in religion or in trade. But let us recall what our generalizations concerning environmental influences can suggest as to the development of a commercial tendency in a society.

It could scarcely be disputed that the sense of the need or desirability of exchange is a mark of that human group which is coming to react more intelligently upon its environment ; and that the development of the apparatus of exchange is, as has been seen (§§ 181-182), one of man's more refined and less obvious devices to secure well-being, or self-realization, or whatever other designation may be preferred to cover success in the struggle for existence. This being the case, the development of the "instinct for trade" can scarcely arise apart from the development of civilization in general. But we have found certain broad conditions that control the latter development ; hence it is no less than obvious that those races which were to evolve an unmistakable commercial bent, and which were then to succeed in making themselves of account in the world of trade, should have always performed these exploits within an environment of the favorable type, as above described (§ 180). The most important regions

of trade have been and are the littoral states of Europe, together with their colonies in temperate regions,—all these being occupied by the white race,—and the littoral regions of temperate Asia, whose commerce was founded and built up by the yellow race. No other of the chief varieties of the genus or species *Homo* has possessed any significant share in modern or ancient commerce, either as producer, consumer, or distributor.

This is about as far as we can pursue race character without challenging considerable dispute. If one should try, for example, to show why the English have been more successful traders than the Germans, or to balance over against each other the Chinese and the Japanese, he would embark at once upon troubled waters. All these questions have become, in modern times, immensely complicated ; and solutions, especially in the face of present-day prejudices, are scarcely demonstrable. But, questions of origin aside, it is of great value to get some idea of the actual disposition and motives of the typical trading nation. If we cannot explain, we can at least describe. Naturally these qualities come out in the plainest, if most naïve fashion, in the simpler cases. The simpler cases are those of uncivilized peoples or of civilized peoples in ruder environments (frontier traders), or they are those of an earlier period of history. The historical cases can be observed, perhaps, with more of dispassionateness. Hence we turn to a sketch of such earlier types, referring the student to Part III of the present book for the more detailed consideration of more complex modern forms.

To illustrate the multiplicity of causes assigned for a modern nation's trade ascendancy, take the case of England. One scholar, having physical environment in mind, will develop the importance of island position, broken coast and harbors, navigable streams, mineral wealth, the proximity of deposits of iron and coal, and the like. Others, who think race character determinative, and refuse to believe it a product of environment, will cite the sterling or other traits of the British : common sense, practicality, reserve, coolness, industry, seriousness, respect for law, piety, honesty, trickiness, arrogance, godlessness, and a score of other, perhaps contradictory, qualities. Others will assert, as causes of commercial success, good government and laws, freedom, discipline, isolation from continental wars and consequent invasion, strength of navy and merchant marine, good system of money and credit, wise labor laws, freedom of trade, and so on. That all of these are not true, or that those which are true are reducible to a few basic factors, would be difficult to show.

194. Mediterranean beginnings. It is intended, then, that the following brief sketch of earlier conditions of commerce shall throw light upon the environing influences and the racial character of typical

merchant peoples, and in addition upon certain simpler forms of exchange and of commercial devices. The reader is left to form his own opinion as to the relative importance of these two leading factors, and is invited to note the progressive complication of the originally simple apparatus of trade. It is likewise hoped that our survey will serve, together with the following chapter, as an illustration of the manner in which history is built about exchange, and as an introduction to the trade conditions of the modern age.

If we try to trace the trade movements of the West toward their origins, we are able to follow them, before the ascent of the stream brings us to the confluence of a number of individually insignificant rivulets of primitive barter, to Assyria and Egypt. These ancient seats of civilization, in the valleys of the Euphrates and Tigris, and of the Nile (§ 166), had developed a certain amount of internal trade and were beginning to become aware of the advantages of mutual exchange many hundreds of years before the Christian era. But neither of these peoples could be called commercial. They were producers and consumers, with a variety of wants to satisfy, but, so far as they themselves were concerned, they made no decided move away from the typical group isolation of still more ancient and primitive times.

In the region between the empires, however, there developed the first genuine traders of the western world. These were people of Semitic race, closely allied to the Hebrews and Arabs — the Phœnicians. They seem to have profited in very early times by their intermediary position between Assyria and Egypt, and to have organized an early exchange (by caravan) between the two empires. But they began to venture upon the sea at a very early period, at first in search of a species of mollusk from which a purple dye was extracted, a dye which was in great demand in the ancient empires, purple being the royal color. The Phœnicians took to the sea, then, as neither the Assyrians nor Egyptians could. Environing conditions favored this development, as Phœnicia was hardly more than a thin strip of coast line; the forests of the Lebanon hills, which formed the eastern boundary of Phœnicia, also contributed their part, for the best cedar for shipbuilding was abundant and near. However, the political encroachments of Assyrian and Egyptian rulers forced the Phœnicians to take to the sea for safety's sake. Thus were offered to or forced upon this small nation exceptional opportunities for developing the earliest merchant shipping of the Mediterranean.

The Phœnicians were of a disposition to seize the offered chances with alacrity. They either possessed already, or speedily developed

a character well suited to the function which they were to discharge. Where this disposition came from we cannot say; they possessed it in common with their Semitic congeners, Hebrews and Arabs, though they seem to have developed it before either. They were soon, to judge from the earliest records which we have of them, single-minded merchants, caring for nothing except gain, and possessing all the easy adaptability, cleverness, resource, and unscrupulousness of the seasoned frontier trader. This well-adapted type, with its preliminary advantages as recounted, was enabled to begin its operations at the most favorable end of the most favorably arranged mediterranean on earth. Thus the first halting advances of shipping and nautical art were encouraged, as it were, by nature itself; and the Phœnicians, not yet daring to sail out of sight of land, were enabled to crawl from island to island along a broken coast, until they reached Greece. Then the distances between halting stations began to widen as they became able to pass over them, and this people within a relatively brief period extended its trading area to embrace the whole Mediterranean (§ 187). Some of the Phœnician voyages even extended beyond the Strait of Gibraltar, and the trading station of Gades (modern Cadiz) was founded about 1000 B.C.

195. Frontier trade. The trade pursued by the Phœnicians was of the frontier type. Such exchange is carried on between a relatively civilized and an uncivilized people, and is immensely profitable because the former are able to take constant advantage of the unsophisticated latter, who can have no realization of the values, in any open market, of what they give and take. For example, the Eskimo may take a twenty-five cent jackknife in exchange for a polar bear's hide; for he does not know the cheapness of the former article, nor the high value of the latter, in the open market, say in London. When the native comes to know the real state of things, the trade is no longer a frontier trade. Now the profit, to express it in a more precise way, is due to the double exchange of commodities between markets of different conjunctures. "The conjuncture is an economic term for the adjustment of supply and demand to each other at a moment of time" (Sumner). In London the supply of glass beads is virtually unlimited, and the demand (and so their value) is small; in Africa the supply used to be practically nil and the demand very large (and so the value high). The conjunctures were diverse. Again, the supply of and demand for ivory in London make it very valuable, while in Africa it used to be plenty and relatively valueless. If, now, a trader bartered glass beads for ivory and sold the latter in London, he was exchanging in a sort of double fashion between markets of widely diverse

conjunctures, and his profit was very large. This is the kind of trade the Phœnicians drove, and it is not marvelous that they became devoted to it. No compunctions assailed them; in fact, they were regarded in antiquity as cheats and liars, but were tolerated only by reason of the material advantages obtained through them.

In general, their trade resolved itself, then, into an exchange of finished products of the arts (metal work, dyes, drugs, and other eastern products, domesticated plants and animals (§§ 159-160), and the like), over against raw materials (chiefly metals and grains). The method of trade was barter of a primitive type, and exchange of commodities did not always rule out an exchange of blows; trade and piracy were different aspects of the same operation (§ 182). The policy was one of monopoly and of exclusion of all rivals from the profitable occupation. It is thought by some that the sea terrors of the *Odyssey* were mere "commercial myths" fabricated by the Phœnicians with a view to deterring possible rivals from entering their field of profitable occupation. What the Phœnicians did was to transport the characteristic products of the East to the West; they thus initiated that long phase of history which is built about the Mediterranean and its commerce. The civilizing effects of their activity will appear a little further on (§§ 200 ff.).

196. Later Mediterranean commerce. After the Phœnicians came their supplanters, the Greeks, pursuing essentially the same policy, though exhibiting considerable deviation from the one and fixed idea of their predecessors. To enter into detail respecting their trade history would be to repeat much that has been said of the pioneers. Under the Roman power the Greeks and others continued to purvey eastern products to the western world until, with the fall of the Empire, the commercial development of the western Mediterranean received a rude setback and was brought almost to total stoppage. This period is practically barren for our purposes; but as time went on a recovery set in, and relations with the Levant and the East were renewed. The widening gulf between the Levant and the Occident was bridged over by the Crusades and by the commercial activities of the Italian city republics, chiefly Venice and Genoa; for the western world had been so thoroughly educated by the earlier commercial peoples that when the easterners ceased to bring their wares the westerners went for them. Thus did trade development seem to take a reverse direction, although it was really only a matter of change in the carrying agency.

It might be said of the character of the Italians that in most respects it belongs to the same category with that of the Phœnicians.

They were shrewd, resourceful, tricky, intent on gain alone. They derived all sorts of advantage from the Crusades, but were in, not of, them. They remained on good terms with their customers, the Saracens, whatever the attitude of the Pope. They fought bloody wars among themselves to secure monopoly and universal exclusion of rivals. In short, they were the Phoenicians of a later age, and their decline, like that of their prototypes, was largely due to the habitual display of the same species of temperament and character.

But the things which the westerners wanted had somewhat changed in identity. They were now provided with the processes and dexterities formerly monopolized by the more civilized East, and the day of frontier trade was long over, at least for the countries bordering the Mediterranean. During the period of the Roman Empire there had begun to enter upon the markets of the West certain products of the Far East, chiefly silk and spices; for the activity of the eastern centers of culture development, in China and India, and the energy of the carrying trade of the Arabs, had begun to dig out channels of commerce toward profitable markets (§§ 187-188). In the course of time the condiments and spices came to occupy a position of surpassing importance (§ 154), so that the trade of Venice became progressively more and more confined to these articles. The chief spices thus entered upon the European market were, above all, pepper, then cinnamon, cloves, ginger, mace, and other products of the Far East.

197. Complementary trade areas. But these are products of the South rather than of the East; they are one and all tropical plants or trees, such as the European climate could not foster. Their entrance upon the markets of Europe represented the first contact in history of this part of the temperate zone with the tropics. The great enthusiasm of the European for these products is difficult for us of this day to explain (§ 154); but it is clear that he meant to secure them by any and all means. Europeans had no acceptable natural products to offer in exchange for them, for, as has been seen (§ 175), the tropical people stood in little need of an imported supply of materials for food or clothing; but their progress in the industrial organization and the arts enabled them to offer various manufactured products, and metals in the form of money. The two areas, the West and the East, began then to develop a complementary trade relation; they remained "West" and "East" because the tropical products long came into the Mediterranean via Damascus, Beirut, or Alexandria. What all this amounts to is, obviously, the connection of the two naturally complementary trade areas of the tropics and the temperate zone.

Natural conditions had lent to each a development different in quality from that of the other (§§ 174-175). Each had characteristic products that proved attractive to the other. And in proportion to their greater energy the northern peoples began to assail the natural barriers which separated them from their desires and profits. A more perfect consummation of this connection became from now on, and through the Discoveries Period, the aim of the several rival Italian republics and of their successors in trade supremacy. Out of this intense desire supplemented by others (religious zeal, etc.) came the rapid succession of "conquests over nature" of the Discoveries Period, which initiates the modern age. And in proportion as this connection was the more perfectly realized, the nation which effected it reached toward the commercial supremacy of the western world.

The importance of this motive in history has often been emphasized but seldom overestimated; it is one of the most striking examples of the making of history about an economic issue. The North has always been reaching out toward the South, in the guise of the West seeking the East, since the Phœnicians had first awakened the West to the possibilities already realized by the nearer East. Alexander and the Cæsars strove toward the East, attracted in part by its superior culture and consequent richness as a field for exploitation. Venice outstripped her rivals because of her success in consummating her connections with the eastern empires, and of the wealth that came to her through the resulting intercourse. And as civilization moved westward with trade, the Portuguese and Spanish began to cherish a desire to share in the great bonanza of the age—a hope none the less strong because long balked of its fulfillment by the monopoly policy of the Italians. It was this desire which, in its strength, drove the Portuguese around the Cape of Good Hope to get directly at "the wealth of Ormus and of Ind"; and the same motive caused the right-about-face of Spain. Columbus by sailing west was to attain the "East"; he too was after spices and gold. Again, the same desire led the Netherlanders to infringe upon the sacred Portuguese and Spanish monopolies, and then the Danes, French, and English. Possession of the centers of Oriental trade was the object of strife between these latter nations until approximately the present status in the East had been worked out. In such manner history was made about the trade which was to connect two typically diverse physical environments, complementary in a certain sense one with the other.

198. Commercial types and areas. What has been said should give the reader some further idea of the dependence of trade upon

natural conditions, and of the position of importance which the trade motive may take in history. But the simple directing of national attention and cupidity hither or thither, and the resulting collisions and readjustments are far from constituting the total influence of the commercial prepossession. The agents of trade, largely without premeditation, have exerted the strongest of civilizing influences throughout history. Let us consider that phrase "without premeditation." From the Phœnicians of old down to the Discoveries Period and later, the race character of the chief commercial peoples has exhibited as its dominant feature the desire for gain, and this through the first best means. So that if one were called upon to define, after these examples, the race character of the typical merchant people, he might say that the number and diversity of their wants, and their energy and skill in the satisfaction of them, regardless of others,—except in so far as assumed regard was found to bring its own reward,—have been the salient features. But these are the qualities which we have found developed under certain climatic

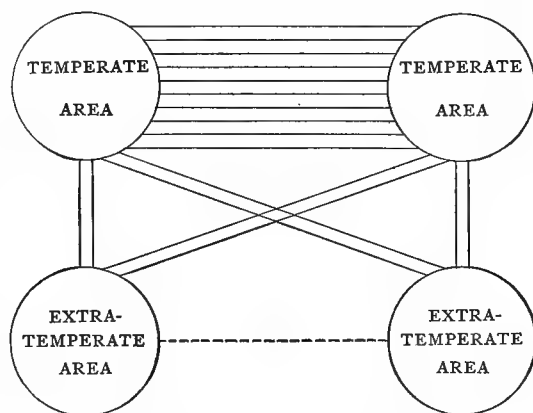


FIG. 22. Trade between Zones (schematic)

and other conditions alone (§§ 146–148, 174–175). It may be repeated that in general the matter of race character and the distribution of trade according to it seems to reduce itself to this: that the influences which favor the development of material and other civilization promote also the growth of exchange and of the commercial instinct. Hence the greatest foci of trade will be the centers of highest material civilization. What these were in earlier and are in later times we have already noted (§§ 172–174, 181). It is therefore not at all difficult to see why the bulk of the world's trade is between Europe and the temperate regions which she has colonized, that is, between parts of the temperate zones. The volume of trade sinks as other climatic areas are taken to form one set of the terminals, and vanishes almost to nothing when both parties to exchange are found outside the temperate zones. Figure 22 roughly illustrates such proportions of trade movement; this figure

might be taken to be a schematic representation of the world's trade routes. It also represents in some fashion the prevailingly latitudinal direction of the ways of trade. For the present purpose of getting a general perspective of commercial development, the determination of the influence of race character can hardly attain more precision. It begins to be clear, however, why the merchant peoples are located where they are, and why the center of gravity of the world's trade has ever moved northward (as well as westward) as the competition has become more severe and protracted.

But to return to our cases : the Phœnicians certainly constitute the extreme example of the commercial type. They subordinated to commercial gain things which most peoples are not willing to renounce : language, religion, customs, and even national and racial identity. As a race they have passed away ; there are no "Phœnicians" now to be found. Least of all did they have any "mission," religious or cultural (§§ 194, 200). Certainly whatever they accomplished in the spread of culture was "unpremeditated." Similarly with the Greeks ; though they went to no such lengths as did their predecessors, the difference was of degree and not of kind. The Romans, not being a people commercially inclined, fall out of our reckoning ; yet it is worth noting that whatever culture-dissemination they did was scarcely due to premeditation. Everything under the Roman system, including trade, was strictly subordinated to one purpose, and that purely of self-interest — the maintenance of rule. The mediæval Italian merchants might be expected, at first sight, to have followed a somewhat different course. The easy tolerance of the ancients for whatever was alien in religion and custom undoubtedly rested largely upon the absence of any real and vital distinctions between the various forms of these latter as exhibited around the Mediterranean, for they all were of an essentially similar type ; but the Italians were Catholics, in possession of a religion which would not brook a rival and which condemned in a body many of the customs and habitudes of non-Christians. Hence it would be supposed that the tolerance of preceding centuries would be absent. But this was not the case. The Venetians and Genoese operated essentially as did their predecessors ; they were, as we have remarked, in, but not of, the Crusades, for they rested content with such conquests as furthered their commercial purposes, and after they had collected much from the Crusaders in payment for transport, and had gotten a foothold in the eastern cities, they ceased almost entirely to take part in the Crusades. In contrast to the Crusaders they were on good terms with the Saracens. Commercial gain was again the

chief and practically unique preoccupation. This attitude did not at all please the Pope, who saw the Italians trading with and affording comfort to the professed enemies of the faith.

In fact, it seems that there existed at this time, and later, a fundamental antagonism between the Catholic religion and the development of commerce. It is easy to see that the retention of customers depended largely upon respect for their local social forms and traditions, — and this the trader was quick to perceive and to act upon even unconsciously, — whereas the attitude of any infallible faith could only be intolerant. This antagonism of the religious and the economic motives went on through the history of the Portuguese and Spanish empires, and became particularly marked when the church, in the person of the monks, tried to withdraw the natives in Portuguese and Spanish America from the control of the planters who needed them for the production of articles of exchange (gold, sugar, etc.).

199. Colonization. The character and attitude of the specialized trader come out clearly enough in what has been said. The type has persisted into later times; the Dutch of the seventeenth and later centuries could well have stood comparison, especially in the cynicism of their attitude toward backward peoples and in the sordidness of their preoccupations, with any of their forerunners. Naturally trade was likely to fall into the hands of those who would pursue commercial ends thus single-mindedly. It will presently be seen that the spread of culture seems to have been checked in no way through the non-existence of other than material aims in the minds and characters of those older merchant peoples who diffused it together with the extension of their gainful enterprises. But before considering the civilizing effects of trade it is desirable to touch upon another grand phenomenon connected with commerce, that is, colonization.

Here we can no more than glance at one of the great sequels of trade development.¹ The majority of colonies have either begun as trading stations or have soon fallen under the attraction of trade of the frontier type (§ 195). The trader, as soon as his business began to yield any profit worth mentioning, was obliged to surround himself with a certain amount of the apparatus of trade — storehouses, extra stock, etc. — and to become essentially sedentary in his ways; a peddling trade thus changes into a sort of localized form. But the "plant" of the settled trader is more or less continually jeopardized under any "native" government, and business operations are rendered tedious, insecure, and unprofitable. Hence it has been the regular rule that the mother country shall extend her own sway over

¹ A treatise by one of the authors of this book deals with Colonization largely from the standpoint here occupied.

the vested interests of her subjects in foreign lands of a low civilization. But from these two activities — settlement and extension of metropolitan control — arises the colony. Colonization is therefore the almost inevitable outcome of a brisk and profitable trade. And because settlement in temperate zones is attended by far fewer dangers, the most populous and productive colonies are all located in temperate regions (§§ 143–148, 172). But it is this very populousness and productiveness that give to a colony a strong influence over the natives of its region.

Consequently, the colonies of the temperate regions have been sterling agents in the extension of civilization. The early Phœnician settlements were depots of transfer of the Assyrian and Egyptian culture toward the west, and the colonization of the Greeks Hellenized a large fraction of the Mediterranean coast peoples. The civilizing effects of the Roman rule, felt in good part through the agency of the *coloniæ* (though these were prevailing of a military character), are well known. And the mediæval Italian settlements in the Levant were factors of great moment in the collection of eastern products and processes, which were then introduced into the remoter western parts of Europe. In later ages the colony has been relatively less effective in the diffusion of culture among backward races, for reasons presently to be explained (§ 204), but during the Mediterranean period of commerce it certainly discharged a conspicuous function along these lines.

CHAPTER XIII

TRADE AND THE ADVANCEMENT OF CIVILIZATION

200. Nature of early trade relations. Returning now, with the advantage of our preceding survey, to the topic of the civilizing effects of trade, we might take for a text the common saying that "trade is the handmaid of civilization." This expression, however, does not seem to strike off the exact relation between the two ; trade is rather the forerunner, the way preparer, the herald of civilization. All these relations, as has been said, can be more clearly made out in the simpler cases of earlier ages, for the conditions of modern times are so hopelessly complex that no acceptable analysis of the effects of trade as distinguished from those of divers other factors can well be made. But if the history of the Mediterranean countries before the period of the Discoveries be scrutinized, it is possible more clearly to demonstrate the activity of trade in the spread of civilization. After considering this earlier period, one is in a better position to assign to trade its due recognition as a culture agent in modern times.

In the earlier periods, as has been seen (§§ 193, 198), the temper of the trader was peculiarly single-minded ; he had no particular sense of his capacity as an agent in the spread of civilization, and if he had had, he would not have assigned it any great importance. The idea was to gain all the material advantages possible from trade ; the fact that while so doing he was benefiting the world to come, entered casually, if at all, into the trader's mind. There was, in these earlier days, no strong feeling that a certain religion, or set of customs, was inalterably right, and so must be imposed upon the world. It was conceived to be natural enough that people should differ in the details of such matters—and it was only in the details, for the religions and customs of the Mediterranean peoples were, as has been said, of an essentially similar type. Hence there was no intention or even desire to effect any changes in the status of backward peoples, except to stimulate their material wants and their demand for commercial products. If the case of the Roman power be cited as an exception, yet it is characteristic of the Romans that they did not strive to make changes in the manners and customs of the subject peoples beyond

those which were necessary for the safeguarding of Roman rule. Hence there was no idea of a "mission" of any kind until the rise and spread of the great religions placed upon their adherents a certain proselytizing responsibility, which led them to attempt the alteration of local beliefs and habitudes. In other words, up to the end of the Middle Ages the factor of trade can be regarded as operating almost in isolation. Except with the Romans, there was scarcely any extension of political domination on the part of a metropolis over its colonies, or of the colonists over the "natives" among whom they lived. Neglecting, then, the civilizing influence of the Roman rule, which it exercised through the imposition of discipline, the relations between peoples of a higher and of a lower degree of civilization were based substantially upon trade. Indeed, under the Romans themselves one of the greatest educative effects of their discipline was the extension of the *magna pax romana*, under whose ægis trade found such security and attained such regularity as are essential for its well-being (§§ 182, 212).

The results of such trade relations have been of the most far-reaching nature; the whole stream of western civilization flows out of them. Without the activity of the Phœnicians and Greeks, unquestionably the development of western Europe and her colonies would have been at least delayed, and very likely for several centuries. The Phœnician trade routes have been in later times the routes of material civilization, the courses of Roman rule, and even the paths of Christianity itself. The Greeks took up the function of the path-breakers and discharged it with enduring results. And the Venetians and Genoese, together with other of the Italian city republics of the late Middle Ages, followed back to the East over the old routes, and kept alive the fruitful relations between Levant and Occident which threatened to meet their end under the strifes and hatreds engendered by the Crusades. More specifically, the Phœnicians carried to the West the products, and then the processes, of the more highly civilized East, spreading toward the West the possession of the more refined products of the arts of agriculture and animal breeding, and of manufacture, and then the arts themselves. This they accomplished through the regular trade in material objects, in animals, and, last but not least in importance, in men; for the universal kidnapping and slave trade of remote antiquity brought about a certain exchange of knowledge and dexterities between many districts of the Mediterranean. In brief, between the time of the early Phœnicians and the Discoveries Period the civilization of the East was made into a

patrimony of the whole western world, as then known ; and this was done, certainly for the most part, through the influence of trade ; at least there existed no other educational factor of such generality and strength. If this is so, then trade was, in these earlier times, the "handmaid of civilization," and something more.

201. Civilizing effect of exchange. But let us see how it was that trade had so important a function in the spread of civilization. In any human society the most fundamental activity of the group must lie in maintaining its own life — in having its members live. But to secure this end, each group develops an organization of industry, a concerted attack upon natural conditions. This is the most elemental expression of its civilization (§§ 139, 140). Having succeeded in this respect, it naturally engages in the effort to live more abundantly, i.e. to raise its standard of living. In so doing it evolves a number of simple rules of conduct that gradually become custom and precedent ; it marks out spheres of rights of individuals and of groups, that they may not collide with each other and disturb the equilibrium and friendly coöperation of the whole society. Such rules of conduct extend into the ordering of sex relations and of family life, into the more or less rude definition of property, and of the form of government. When such rules are of long standing, the natural inertia of men opposes their sudden essential change. Such alteration would throw life out of gear for the ordinary group member to whom the customs and habitudes have become "second nature," and who is incapable of rationalizing upon them.¹

Now if it is desirable to alter the group in respect to its civilization, it is necessary to begin at the bottom by striving to change the terms of the struggle for existence, thus inducing a modification of the superstructure of customs, institutions, and the like, that are built upon it and follow its guiding lines. The surest way of effecting a thorough alteration would be, plainly, to change radically the physical environment of the group (cf. § 136). This is what is done when, in modern times, a superior race occupies the habitat of a less-developed one ; it cuts down trees, exterminates game, builds inclosures, makes regulations, etc. — all for its own advantage and with no thought of the fate of the former owners of the land, the "lower" race. The latter is thrown completely out of harmony with the modified environment, its body of customs and habitudes is soon out of joint, and, unless it can speedily effect a complete revolution in its ways, — and this seldom or never occurs, — it becomes demoralized and degenerate.

¹ See Sumner, *Folkways*, Chaps. I–III, et passim.

Theoretically, if the backward race is not too far behind, it might accommodate itself to such alterations (which would be to it less revolutionary than to the very backward type) and rise to a higher plane. But it is clear that the transformation brought about in the peoples of western Europe by the Phœnicians and their successors was not due to any change of natural conditions; the traders were too few and had no such purposes in mind as would have led to the effort necessary. The next most fundamental way of inducing a change in a group's life is by putting it in the way of performing its simpler reactions against its environment a little more effectively, that is, of bettering its industrial organization — its concerted assault upon nature. This is the way of attacking the question next most fundamental to environmental alteration. The idea is to stimulate wants and desires for the attainable, and then supply what will gratify them, operating always upon such desires as are already present in a slightly less developed, or at least potential, form. This is what the traders did, almost unconsciously; for to stimulate a demand and then supply it at a profit, the larger in proportion to the newness and unsatiated character of the demand, is the prime preoccupation of the trader, especially upon the frontier (§ 195). If, now, the industrial organization is thus bettered and extended, there should gradually grow up, upon this altered foundation, a set of customs and habitudes adapted to the higher plane of material existence attained; or, at least, the validity of the old should be shaken, and any suggestion as to their alteration, even though unconsciously given, should be more hospitably received. But the alteration of such customs and habitudes toward the type of those developed by the more highly civilized peoples, under their own long-altered industrial organization, is what is regarded as advance in civilization. Hence the theoretic tendency of trade would be to prepare the way for a higher culture.

202. Other civilizing agencies. To make the case the clearer, and before concrete illustration of what has just been said is given, let us briefly consider the effect of other lines of attack to secure the same end. Such other methods are bound to be prevailingly of conscious adoption, and are likely, even though there be no idea of a mission of enlightenment, to be coercive. The Roman conquests unquestionably secured, through methods of coercion, a large degree of success in uplifting peoples of a lower stage of development. But, as has been already suggested (§ 200), this result was largely due to the enforcement of peace and the consequent suppression of those intra- and

inter-group strifes which, among peoples of an unsettled discipline, are always crossing the development of the organization of men against nature. The Romans were remarkably tolerant of their subjects' customs and beliefs in so far as the latter did not interfere with the progress and solidification of Roman rule. This was one of the great reasons for their successes, not only in holding the empire together, but in advancing the fortunes of subject peoples. The latter adopted Roman ideas and customs because they saw the use of them under the more settled and industrial conditions now possible. The Roman language gave them more ease in speaking of the new relations, for it included names for new things just coming into their purview with the advancement of their material civilization and the elevation of their standard of living; the Roman law corresponded to the needs of new relations in all walks of a more ordered life; and so on. Hence the coercive measures of the Romans were of a civilizing nature, as those of later conquerors have seldom been. They were constructive and disciplinary. What the Romans did was to apply their practical minds and executive ability to the task of organizing the civilization of their time; thereafter it advanced with greater smoothness and coördination. And, after all, the Roman influence toward the elevation of civilization was exercised, to all intents and purposes, unconsciously, or at any rate the driving force was self-interest. In this respect it coincides with the activity of the early Mediterranean trading nations.

In later times the conscious motive or mission of uplifting other peoples has played a part practically unknown to the ancient and mediæval times. It means, of course, that these lower peoples shall be made "as we are." But those who attempted such transformation had their eye not upon the fundamentals, as we have seen them, but upon the more obvious customs, habitudes, institutions, and beliefs upon which a group rests its individuality and superiority. But these things we have come to view as, one might say, secondary social forms resting upon the primary, and normally modifiable only through antecedent modification of these latter. A purely hunting tribe cannot understand a system of private property in land; the fundamental and maintaining activity of the group demands that every one shall have the usufruct of the whole hunting ground. There is no object in dividing it up. Now, any people is sensitive with regard to these secondary matters, — family and property relations, religion, and so on, — and there is no much surer way of alienating either individual or group than by a direct and contemptuous attack upon long-settled

habitudes of life, than which no others are known or respected. Moreover, if by force these secondary matters are suppressed or modified, without a corresponding change in the basis upon which they rest, there can be no longer any harmony between the group's life conditions and its manner of living; and this means bewilderment and demoralization. If this is true, the great superiority, at least in earlier times, of the agency which rouses no antagonism, but yet strikes deep at the economic root of a society's life, becomes the more clearly apparent.

203. Adaptability and efficacy of trade. The trader's business, in all ages, is to placate his customers, for only thus do profits accrue. Hence by a very instinct he lets the private individual or group interests of his clients alone, and tries to tempt them with what they want or can easily be made to want. But what they want, since every group is well satisfied with its own way of living, and convinced that its customs are best, are mainly material things. An American Indian may not care for a copy of Shakespeare's plays, but he does immediately sense the superiorities of the steel ax over the flint one, and of the gun over the bow and arrow. His family and social system, his religion, are not open to discussion, for they are in the body of a life policy bequeathed to him by the apotheosized dead. But variations in the material outfit of life can be concretely tested and selected when tactfully presented. If, now, we turn back to the early Mediterranean traders, we find them in full possession of such insight into the barbaric mind. To demonstrate this fact it is only necessary to catalogue the articles of the Phœnician west-bound traffic: metallic products, fabrics (especially linen), wine, oil, prepared spices, incense, perfumes, dyes, drugs, embalming mixtures; domesticated animals and plants (grains, trees, etc.). Plainly all these could come under two categories: products of another zone, and products of a higher culture. The latter exercised a livelier incitement to progress, the more so as they could be duplicated nearly anywhere, provided the knowledge of the processes could be obtained. But it would be a dull tribe indeed—and the peoples about the Mediterranean were not dull—that could not pick up something of the processes from observation of the products, and besides, the slave trade furnished teachers in the person of kidnapped members of more civilized communities. Thus, beginning with the easily stimulated desire for a bronze ax, or a better plant or animal, the influence of a higher culture could come to be pervasive of all the groups with which it entered into contact. For after the less developed societies had been provided with the most obvious advantages of a

higher material civilization, they were ready to reach out after the more complex and refined ; they would want better and more uniform weights and measures, less primitive methods in trade, better shipping and knowledge of navigation, a more developed conception of mine and thine, more intelligent theories of life in general — in short, a better equipment, both material and intellectual, for the struggle for existence. All these things might come as the direct results of trade with thoroughly self-seeking traders, as those of antiquity were ; and they did come, first to the Mediterranean peoples and then to those farther to the north and west. Whatever view is taken of the causes of this extension of culture must include a large recognition of the factor of commerce. One might go further and cite the disintegrating effect of trade upon the feudal system, and show how it was the activity of the Venetians and Genoese that ushered in the modern era, with its initial feats of the Discoveries, all the most important of which were motivated to a predominant degree, directly or indirectly, by trade interests or prospects.

We have seen in preceding pages (§§ 166, 173) that civilization is a product not only of numbers but of the contact of numbers. It was trade which, above all, secured such contact in the earlier periods ; and it was because this trade operated as a factor in harmony with the predisposition of its age that it managed to exert, unwittingly and without premeditation, such a strong civilizing influence.

204. Trade's civilizing function in different periods. Such influence has not been confined to ancient times. Trade is still the great educative factor as between peoples of diverse degrees of culture, if not as between those of approximately equal attainments. For several reasons, however, it has not met in later times with the striking degree of success which was reached when the western world was younger. First of all, modern trade has not had the same ground to work upon, for the commerce of the pre-Discovery Period had succeeded in effect in bringing together all the European nations into a common market, that is, in exhausting the frontier trade in so far as it applied to peoples fitted by environment and race character to rise speedily to a high civilization (§§ 148, 174, 193). No such results in the spread of culture could be hoped for from contact with American Indians and South Africans as were attained through the purveying of products to European stocks, to so-called "active races," like the Greeks. Later civilizing agencies have had to do either with the backward races of the temperate zones (Americans, Australians, Hottentots) or with those many tropical peoples whose environment has not

conducted to their advance in civilization or receptivity for ideas of culture. There has been developed through the ages, as between the more and the less developed races, a great chasm, as it were, and a contrast of superior and inferior (§§ 147-148, 174 ff.). The bridging of this gulf is a matter of long time and arduous effort, if, indeed, it is possible. Hence no means whatsoever have availed to raise the less developed races to take their place on a par with their educators, as the less developed peoples of Europe with comparative rapidity came to do. This is the great and crucial consideration ; but there are others that may be named more perfunctorily. In later times the movement of civilized races into the habitat of savage races of the temperate zone has been so massive and overwhelming that it has swept the natives from the field before they had a chance to become civilized ; nothing such took place in the pre-Discovery Period. Again, in later times, the element of overreaching and dishonesty in trade, together with the tendency to purvey hurtful commodities, has become so highly developed, in dealing with unsophisticated peoples, that it is often said that trade actually opposes civilization. Also, while traders in early times used violence if they could, they have been able in more modern times to control such superiority of force (firearms, etc.) that their will has been too often imposed upon a people entirely against its desire and apart from any choice or demand upon its part for products offered. Instead of trading, the nations of a higher civilization have exploited, especially when they were opening up a tropical region where they could not themselves sojourn for any considerable time (§§ 144-145). Besides all this, a multitude of other factors have, in later times, combined with that of trade ; and the result is that the separate action of any single one of these, including trade, can scarcely be estimated. Political subjugation and government, missionary activity, educative systems, and the rest, all enter now as factors, each hailed by its partisans as supremely beneficial for the uplifting of the benighted.

The earlier civilizers had it more simply : they came into contact with groups of their own race, in their own climatic habitat. These groups were characterized by no obvious differences, and the stages of culture were separated by no impassable chasm. There was no "native-labor question." Apart from Rome, whose influence has been characterized, the metropolises (being cities or small countries) did not possess the power to subjugate utterly, but had perforce to exhibit tolerance and to do their teaching by example and suggestion rather than with the aid of the rod. And, above all, this their influence was exercised unconsciously, and its results are thus referable to

the interplay of natural forces rather than to the will of man. How far superior and how much more unerring in securing results these elemental forces are has already been explained (§ 141).

But it is the firm belief of many that trade is still, with all its modern drawbacks, the prime agency in the spread of culture ; that if anything could, or can, uplift the lower races to a place where they can compete for and hold a position in the new world order, it is trade. In any case, the opinion is gaining ground that to effect any such elevation of the backward races the point of attack is that old one of trade — at the bottom. Medical and industrial missions, by their superiority over more purely religious ones, bear witness of this truth ; it is seen that the first education a savage needs is that which issues in bodily well-being and in production. But production, in any but a minimal degree, itself means trade. It is safe to say that exchange has been the greatest and will always remain a superlatively important agency for the elevation of the race. The more developed races are constantly uplifting themselves by the advancement of mutual trade relations. The development of such relations means the growth of understanding, tolerance, and sympathy, and the gradual dissemination of what each has among all ; it leads, through international specialization and division of labor, to world coöperation in the struggle for existence and for a higher standard of living on the part of all civilized humanity. The trade in things means presently the exchange of ideas, not only those of a practical bearing, but also those which deal with art, music, and all the other higher forms of culture. So that, giving trade its due, — and no more, — it is certainly fair to call it the “handmaid of civilization.”

CHAPTER XIV

TRADE MANIPULATION. SUMMARY OF PART II

205. Possibility of manipulation. Hitherto trade has been considered as a sort of grand human expedient in the struggle for existence, developed all but instinctively by men under certain natural conditions, thereafter to have a species of life of its own, and to run its course almost as a basic social agency. We have now briefly to consider in how far man can control the character and channels of trade in pursuance of certain purposes, short-lived or inveterate, wise or foolish, that he has conceived from time to time.

In the foregoing much has been said of the determination by natural conditions of the type and courses of exchange. In so far as it is thus controlled, its essential alteration seems all but impossible. Whatever New England hothouses may do they cannot raise bananas for the trade. In general, where nature has made a decision or a disposition, it has to stand. In saying this, however, we have not forgotten what has been said above concerning, for instance, the improvement of domesticated stocks or the transplantation of organic life, sometimes into regions widely remote from those of origin. Instances could be multiplied where governments have deliberately labored to free their subjects from the necessity of acquiring certain articles of commerce from beyond the bounds of their political group. The Agricultural Department of the United States has devoted much highly successful effort to the naturalization of certain food and fiber plants (§ 214). But the fact has been previously emphasized that such enterprises rest really upon skillful adaptation to natural conditions (cf. §§ 158-159); a certain plant may thrive only within a certain type of environment, but this does not imply that wherever that type is found, there the plant will be met with also. In any case such manipulation of trade as is represented by scientific enterprise of this stamp is not of the species which it is here intended to consider.

As has also been seen in the foregoing, the character and course of exchange are determined, in the second place, by what has been called race character (§ 193). This term, so far as trade is concerned, covers the way in which human interests are felt and in which their

satisfaction is sought. But such interests, when consciously felt, are not seen in the same light, as respects their relative importance, by all men at the same time, nor even by the same men at different times. And looking forward to the satisfaction of an interest that is felt in common, there may be great diversity of theory as to how it may be attained, or how best attained. In other words, there intervenes between the interest and its prospective satisfaction a certain play of the human mind, with all its instability and fallibility. The scene is shifted from that which shows the massive, sure action of elemental forces ; these flow beneath all life, but on their surface there is a chance arbitrarily to modify this and that. Men can put many of their theories, right or wrong, into practice (§ 141).

Trade is carried on by human agencies, and man can control and persuade man through superior force or otherwise, imposing the will of a majority upon a minority, or even of a small minority upon a less well-organized majority. Whatever the natural conditions of land or water ways, a government can say how much land transportation shall be taxed or whether ships may enter harbors or not. It can oppose a local form of production to its undoing, as Spain opposed agriculture, or it can foster a weak industry, not well adapted to a country; so as to secure it a profitable existence ; it can subsidize an honestly struggling or merely favor-seeking merchant marine. The operations of exchange have for centuries constituted a favorite field for the activities of social manipulators, philosophers, and prophets, to say nothing of politicians, schemers, and rascals in general. To go into all such activities of man in seeking to control production and exchange would require a volume. The facts are familiar to most people ; the only attempt here is to set them in some kind of general relationship to what precedes, so that the nature of trade can be the better apprehended. They are indicated here because it would seem unfair to pass them over. For further details of the modern system, up to which this part of the present volume is designed to lead, the reader is referred to succeeding chapters covering the data of modern trade.

Trade, then, except in its grand currents, is capable of being meddled with by man—a privilege which the latter has used to the full. Yet, even on a relatively small scale, manipulation may be either entirely ineffective or fatal unless the nature of exchange is well known, and unless only such alterations are attempted as are consistent with this nature. A poetic keeper of bees says that man does what he will with them so long as what he seeks is “in accordance

with their laws and their virtues"; and the same principle is applicable to exchange. Some of the historical results of trade manipulation, now to be sketched, may render this contention more concrete.

206. Taxation and regulation. Perhaps the simplest type of interference with trade is that which takes place inside a tribe or state under the necessary form of taxation. This is really not interference—at least it is not intended, in the ordinary case, to alter the conditions of exchange. The eye is not upon trade, but upon fiscal policy. Trade, like all other interests, pays insurance premiums in the form of excises and various other taxes to the government; it is thus secured, as a taxpaying person is secured, against the ills of lack of government. But such normal taxation may be extended under certain conditions, and made into an instrument of assault or control. The objective is then the trade, not the treasury. Adherents of certain parties would gladly tax certain forms of trade "out of business"; the liquor traffic has been absolutely prohibited in some cases, and in others subjected to "high license." In the belief that certain large enterprises are not subject to such competition as may lower prices, certain people wish by law to fix these prices (e.g. railroad rates) at a lower level. Commissions of various kinds are generally at work in a modern state investigating or tinkering at the conditions of certain businesses with a view to their control. All this kind of enterprise ultimately affects trade, provided it does not aim at extreme alteration of conditions and so nullify itself. Whether such control is good or ill is a complicated question; if it is too drastic, trade either dies beneath it, or crushes it aside and passes on.

Such deliberate interference with the course or forms of trade is that to which we wish here to call attention; it is due, as has been seen, to theory of some sort, that is, to some mental operation called forth in the effect of self-realization (§ 139). Such theorizing may be rational and based upon correct information, or it may be thoroughly irrational, based upon ignorance, misinformation, imagination, emotion, impatience, intolerance of sustained mental effort, preoccupation of one kind or another, and so on. We hasten to our illustrations. In the Middle Ages trade was cramped and restricted by regulations that had their origin in applications of scriptural texts wrought out by men ostensibly removed from the world and its doings (ecclesiastics) and thoroughly permeated by the unreal scholastic atmosphere. They were recluses, yet they lucubrated over trade; they had taken vows of celibacy, yet they tried to control even the most private of conjugal relations; and their results, in the one case as in the other, might

appear in the highest degree ridiculous, if they had not been so pernicious. One of their fundamental premises was that in a trade one party was sure to lose. Hence, since it was not likely that the professional seller would be the loser, numerous prescriptions calculated to handicap the merchant as against the buyer were emitted. Under the influence of this sort of theory it became ignoble to engage in gainful occupation. Again, an immense amount of care was taken to fix upon various articles a "just price," which should then stand immutable. It was forbidden to buy in a place or time of abundance in order to make gain by selling in a region or period of scarcity. Since merchants were obliged to do all these things, and to evade prescriptions based upon visionary considerations, they fell as a class into a position of disrepute. Furthermore, the holy men forbade the taking of interest, upon the irrefutable thesis that money, not being an organic substance, could not reproduce itself.

Naturally these and many other ordinances were constantly infringed and evaded, for we know that trade went on, though the enforcement of such regulations would certainly have destroyed it. Here is a case where regulation was so drastic, yet senseless, that trade crushed it aside and pursued its course. To illustrate how theory may swing entirely around and face the other way, it may be said that it is now a matter of persuasion that both parties to a trade may gain by exchange; that buying in places and times of abundance (even where there is no delivery) to sell in places and times of scarcity tends to keep prices level, besides inciting to economies; and that interest-taking is no longer "usury," a crime or misdemeanor practiced only by low-lived rascals. The Middle Ages were full of ridiculous theory regarding trade, of which the above are examples, because the thinking upon these matters was purely speculative and slavishly classical or biblical. Where reasoning of this type ran out at all into practical policy, as in Spain, the result was grave injury to industry and trade, while those nations which evaded and at length broke away from such precepts, and reacted against the theories behind them, were headed toward positions of commercial dominance.

207. Militarism. Our present concern is chiefly, however, with inter-group exchange; for we are interested, above all, in the most general aspects of trade. Here the first interference that deserves the name lies in the recurrence of that group hostility out of which inter-group exchange emerged, and which it then, reacting, helped to mitigate (§ 182). Primitive groups — which are generally on a footing of mutual hostility — levy, for example, boundary and transit

dues, often so heavy as to amount to partial or thoroughgoing confiscation. This is what the robber barons did to mediæval commerce; they certainly rendered the calling of the trader a precarious one. In truth war and trade may form as good an example of antithetic terms as one could well find. Of all things trade demands security and peace; and so it prospers only by extreme exception among peoples of a warlike and unsettled disposition, or in regions where the power of such is predominant. The general attitude of a military people is contemptuous of the arts of peace, and, among these, of trade. The seizure of Constantinople (1453) and of Egypt (1517) by the Turks presently put an end to the thriving trade of the Venetians (§§ 187, 196), for the rude conquerors despised the Italians and taxed their goods in transit so heavily as to destroy any adequate margin of profit. Arguments demonstrating beyond question the mutual advantages of the lowering of dues were made to deaf ears and to minds incapable of comprehension. Again, the military prepossession in Spain, joined with the religious, led to the oppression of the Moriscos (or conquered Moors) in the Peninsula, and later to an interference with industry and trade so intimate and searching as practically to destroy them both. The national distaste and contempt for industry thus developed among the Spaniards has kept them nationally feeble through later centuries.

Perhaps the most illuminating contrast in these matters is offered by the course of industrial and commercial development of England up, say, to 1815, as compared with that of the Continent. There swept across the latter army after army, back and forth, until finally the Napoleonic period brought a general unsettling and rearrangement of the whole European system. Where armies were marching, industry of almost all kinds was extinct. Meanwhile, England had been free from all serious invasion or subjugation for several hundreds of years, and had steadily pursued the development of a settled and industrial economy. During the troubled times she really reaped benefits from the woes of others, and supplied the destitute or semi-provided continental peoples with the products of which they stood in need. She emerged finally as the predominant industrial and commercial world power; and it admits of no doubt that her prosperity rested upon immunity from invasion and internal strife (largely due to her island form) as much, doubtless, as upon any other factor.

It might be contended that the antithesis of war and trade is one that lies in race character and social evolution, and so should not come under the topic of man's conscious control over trade. This is undeniably the case, if one is insisting

upon strict order and sequence. But the consideration of the antagonism between group hostility and trade so well introduces the subject of control that it has been saved over to this point.

It has been said above (§ 201) that the advance of civilization brings increased tolerance as between groups. It even brings friendship. This is the result largely of trade relations. But it must be understood that "friendship" between nations is as yet far from being the same thing as that between individuals. No motives of self-renunciation and sacrifice enter into these group relations; self-interest is the law of state action, and it is pursued in the impersonal and relentless style common to the great forces of nature and society. Consequently, when this interest is crossed, or seems likely to be, former "friendships" and alliances suffer change, and a total regrouping of the same may take place. For the sake of pursuing its struggle for existence more successfully a state is willing to sacrifice its relations of amity forthwith; it will suffer no slights or impositions from its closest ally, if it is in a position to resist. Hence in the balancement of prospective good and ill, trade relations enter simply as one factor among many in the determination of hostility or friendship.

208. National self-sufficiency. Monopoly policy. Inter-group trade relations have, then, been subjected to a variety of regulation in accordance with the necessity or policy of the time. A warring power cannot allow even a friendly neighbor to provision an enemy, and if he tries to do it, is ready to fight him as well as that enemy. And so arise the blockades, embargoes, and so on, that practically destroy commerce within the regions of their application. But this is crude and simple regulation, as befits a time of war. It is conceived to be a part of the duty of statesmen, during these ages when war stands little chance of being replaced by arbitration as the last resort for settling international difficulties, that their countries shall "in time of peace be prepared for war." This means that they shall aim to be self-sufficient, and, among other things, dependent economically upon nobody — that is, they must be ready to supply their own wants. If this condition were perfectly realized, there would be no need of inter-group trade at all, and, of a consequence, international specialization of function would be of no utility whatsoever (§ 181); but as has been seen throughout preceding pages, there exist environmental conditions which preclude the perfection of such a consummation. Nevertheless, the ideal seems to have developed of realizing self-sufficiency to its utmost; this attitude may not have prospective

conflict actually in view, but it issues in the effort to strengthen a country's resources to the highest possible degree. In so far as this means the full development of its natural advantages, it cannot be complained of — quite the reverse (§ 205). It is only when it results in a net loss by thwarting the localization of production in the fittest places that it defeats its own ends, theoretically now, perhaps, but sometime in actuality.

The determination to attain this self-sufficiency and to increase group wealth irrespective of any other considerations has led to a variety of forms of interference with trade. Of these we can give only a few typical samples. The earliest and crudest was perhaps the establishment of a closed monopoly: a primitive tribe, for example, strives to exclude all other tribes from participation in the use of the flint or salt deposits. Such action is to be expected of such actors, for selfishness is the prevailing attitude of mind in the painful early stages of the struggle for existence. In the restriction of actual trade the doings of the Mediterranean merchant peoples are but developments of the same tendency; for, from Phœnician down, they consistently undertook to hold their rivals back (if they did not dare to attempt actually to destroy them) from the enjoyment of commercial advantage. Venetians and Genoese excluded weaker rivals and then used up their strength in opposing each other; the former limited the German merchants in Venice by cooping them up in certain restricted quarters. The whole Italian policy demanded the resolute repression of all dissemination among the western peoples of knowledge regarding the ways and methods of exchange. Most of our stock trade restrictions found their prototypes in the pre-Discovery period, where they were developed as apparatus for the support of a policy of monopoly and exclusion.

The most highly elaborated instance of this monopoly and exclusion policy is offered, however, by the imitators and successors of the Venetians, the Portuguese, Spanish, and Dutch.¹ After the first of these had discovered a sea route to India, their king hastened to secure divine sanction of his absolute rights in the new trade region. A bull of the Pope, the representative of God on earth, was secured, which assured to the Portuguese the exclusive claim to all lands from Cape Bojador to the Indies. This monopoly was further supported by physical force, and the slaughter of foreigners who entered Portuguese waters was the order of the day. There were no bounds to the extent and rigor of restriction. Then came the discovery of America,

¹ Cf. Keller, *Colonization*, Chaps. III ff.

wrongly conceived to be the Indies, and Spain put in her claim to the sole possession of the new lands. The consequent dispute between Spain and Portugal over their respective rights might look to settlement in two ways alone—through war or papal arbitration, invocation of the latter authority corresponding to what is now known as “the concert of Powers.” Pope Alexander VI settled the counter-claims by establishing an imaginary demarcation meridian drawn north and south through the Atlantic; all east of this line was a grand Portuguese sphere of influence, all west of it a Spanish. For many decades the actual or reputed power of Spain and Portugal, and the force of the papal sanction, left these two nations in nearly absolute control of their half-worlds. Both now attempted so to organize their commerce within their areas as to derive the maximum profit for themselves and to leave as little as possible for others. The case of Spain may be taken as typical of both the Peninsular nations. Spain early established the policy of limiting all the trade with America to one Castilian city, Seville; thus was the stream of exchange forced to pass through a “narrows” where it could the better be controlled and taxed. In America the corresponding “staple ports” were Vera Cruz and Puerto Bello on the Isthmus; while the Philippine trade lay strictly between Acapulco in Mexico and Manila. There was then founded in Seville an organ for the stricter control of commerce, a House of Trade (*Casa de Contratacion*), which exercised minute supervision over the routes, destinations, manner of sailing, passengers, freight, correspondence, etc., of the American traffic. Gradually the commercial movement of the year was limited, not only as to its terminals, but also as to the times and routes of sailing and the composition of the fleets. Partially, it is true, for protection’s sake all the ships were obliged to go together, at specified times of the year, and accompanied by a convoy of war vessels. These were called the Fleets and Galleons. The corresponding arrangement for the Philippines was a single vessel (*nao*), voyaging once each year between Acapulco and Manila. Naturally this concentration of trade in space and time led to the obsolete system of fairs at the American terminals, especially at Puerto Bello; thus the whole commercial movement of the year was artificially crowded into a few weeks of intense excitement and uproar, which was bounded upon both sides by a long “dead time.” The essential artificiality of the system may be seen from the following typical example of its working: no direct trade being allowed between Spain and Buenos Ayres, the products destined for the latter region had

to go to Puerto Bello, across the Isthmus to Panama, down the coast to Lima, and then eastward across the continent to their destination. Thus the system was one of monopoly within monopoly. The exclusion inclosing the whole was that against non-Spaniards, and this was enforced at the mouth of the cannon and with the aid of the executioner ; next there was the more local exclusion of the colonists (who were treated practically as dependents or even foreigners) in favor of the Peninsulars ; then, more locally still, the exclusion of other Spaniards in favor of Castilians ; and finally of other Castilians in favor of the merchant favorites of Seville. Trade was contorted this way and that to provide for all these concentric circles of interest.

209. Results and decline of monopoly policy. Here certainly was an attempt on the grand scale to control exchange. It is unnecessary to pursue it further into its more petty and whimsical regulations. The thoroughness with which this system was enforced by the Portuguese and Spanish makes it, in its outcome, a shining example of the destiny of trade regulation on the large scale. For such a monopoly contained within it that which made for its own destruction ; the more perfect and effective it became, the more did it tempt infringement and aggression. The secrecy of its methods and the ostentation of its power stimulated the imagination and cupidity of the excluded nations ; the concentration of the yearly booty in the fleets from the East and America constituted a temptation hard for the Dutch and English to resist ; the system of regulation and consequent oppression in the new countries stimulated the colonists and natives to make common cause with freebooters and smugglers. It is very significant that the revolution of the Spanish colonies in America had its stronghold in the once isolated, later contraband-sought, Buenos Ayres (cf. § 146). The unnatural conditions of the Seville monopoly injured the rest of Spain, and both the Peninsular states, partly in consequence of the reaction of their trade policy, began already in the sixteenth century a decline from a position of world dominance to one of insignificance and humiliation. Their retrogression is in good part an object lesson in the destiny of those who aim crudely to confine the forces of exchange under a prearranged artificial system. Strenuous efforts in this direction exercised through generations did not attain their object, or attained at most partial realization, only to lose everything almost at once. The forces of trade finally had their way ; dammed up by a strictness of repression never before encountered on such a grand scale, the stream of trade

finally broke through into the regions prepared for it by natural conditions and the natural interests of men. But this new course passed the Spanish by, and the less theory-ridden and more adaptable peoples attained to commercial supremacy.

The case of the Dutch is similar. Upon the collapse of the Portuguese and Spanish monopolies, the Dutch now became the dominant commercial nation. Their former facility in adaptation, however, soon stiffened into conservatism almost as intense as that of their predecessors; they instituted the same policy of exclusion, and again attempted to confine the currents of exchange within selected channels. This they did chiefly through the agency of their chartered corporations, the East and West India companies, which became the prototypes and models of many later trade organizations. Their chief interest was, like that of the Spanish and Portuguese, the preservation of their granted monopoly; they also illustrate with special clearness another feature of the older monopoly policy, the attempt to control prices. For, in contradistinction to business policy of the present day, the older system contemplated the making of large profits from a small movement of goods, rather than of a slight margin of gain per unit of commodity from a large movement. Hence the attempt to limit production represented by the expeditions which the East India Company sent out to uproot clove and coffee trees and pepper plants, and the wholesale burning or burial of spices when the European market seemed likely to become stocked. The whole story of the Dutch companies is one of uninspired and dismal self-seeking, of exclusion on the large and the petty scale, and, when the policy had ground itself into the national life, of commercial dishonor.

As is well known, the fate of the Portuguese and Spanish monopoly holders overtook the Dutch as well. Encroachment and internal disorganization, corruption, and bankruptcy brought the great companies to an ignominious end after about two centuries of activity. Such monopolies have now passed away, for the development, among other things, of means of communication has rendered the policy of secrecy and of isolation, based upon force, impracticable. The modern delimitation of "spheres of influence," in Africa, is but a later and more formal way of saying, "Keep off!" but the development of custom, succeeding the rise of new conditions, has rendered the old crude dog-in-the-manger policy rather unpopular. The "freedom of the sea" and similar expressions, even though they are partly hypocritical, are modern watchwords, corresponding to actualities that would not have been tolerated in 1500.

These attempts to control trade would seem in retrospect to have had in them no promise of success. It would appear from the foregoing cases, and from others which might be cited, that trade has its own laws and ways, and that the attempt to control it, at least on a large scale, is fraught with difficulties and dangers. The comment is sometimes passed upon such trade policies that they were "too artificial." What this means is that they did not take into account the nature of trade, realizing that conditions of physical environment and of human interests are ultimately determinative both of the type and the courses of exchange. It would now be pretty generally admitted, in principle, that the old policies were "false" and "wrong," or, as a scientist would much prefer to say, outgrown and utterly unfitted to modern conditions. Such rude manipulation of trade was natural and inevitable in the setting of its time, though it now appeals to us as irrational and tyrannous in the extreme. It certainly was not so conducive to trade development as something less stringent and primitive would have been; but it was the system of the age for all the most prosperous and successful peoples, with only here and there a dissenter, born before his time, to oppose it. The modern system, whatever its superiorities, could not have been put into operation at that time; its incoming has demanded much and varied development along many lines of social life. It has demanded above all progressive realization, instinctive or rational, of the importance of the limits set to trade manipulation by natural forces. This realization has stimulated some men at least to the actual study of exchange in order to attain to a wiser adaptation of methods to results derived. Enlightened attempts to deal with trade are not so much in the line of out-of-hand control as in that of direction in accordance with its own "laws and virtues."

210. Protectionism. Thus, though the attempt to control trade has not been given up, it has attained, at least in some cases, a more refined and less obvious background, and regulation of competition has taken its place. That the latter may practically amount to exclusion, and may even lead to at least the threat of open hostilities, betrays the relationship of the contemporary and the obsolete. By way of building up local industry and commerce, the state is thus led to impose handicaps upon foreign products in the form of customs dues. These are not, in theory or practice, dues "for revenue only," imposed upon the foreign products that could not possibly (in the physical or in the commercial sense) be produced in the country levying the tax; they are intended rather to raise the price at which

the foreigner can sell so that the local producer cannot be underbid. They are tariffs "protective" of local production. Their very object is to control production and exchange so that these shall not pursue their "natural course." What they plan, then, is a rearrangement of areas of supply, which is, it need not be said, an attempt to exert definite control over trade, its materials and routes.

It is not intended here to pass judgment upon these projects excepting as the effort is made to show where they come into the history of trade. It is evident, first of all, that they are dictated by national as distinguished from cosmopolitan aims; they are the product of local rather than of large-scale social evolution. The welfare of the state levying duties is the only thing considered. There is at times, however, a distinct hostility to the foreigner expressed or implied, which recalls the older and more blunt views; it is thought that he is being made to pay taxes to the levying government. Of course he is not, for if he could not add the duty to his price, and so continue to make a profit, he would take his goods elsewhere. The protective policy is always instituted in favor of the local producer, and it is hoped that the consumer's income will be sufficiently increased to make up at least for the difference gained by the producer in consequence of high prices. In any case the concern of honest protectionists is for their own country, and that alone. Therefore, for weal or woe, this particular method of controlling trade opposes the general trend of trade development, which has throughout history operated to localize production where it can most easily be done, has thus gradually effected a specialization of function based upon ever larger units, and has, in the course of doing these things, gradually introduced tolerance and even friendship between nations. Inevitably the practical man who has his eye on national or even local development would regard any "cosmopolitan" aspect of the case as the dream of a visionary.

We are fully aware—as who could not be, in this country?—of the argument for trade regulation which asserts the virtual helplessness of an "infant industry," however favorable otherwise its conditions, in the face of organized competition of older rivals. It is not relevant to our subject to touch upon the deep political corruption and social evils connected with trade manipulation calculated to do away with this natural disability; least of all do we wish here to argue the local case. We merely note that, judging from the course of trade development, return to regulation on a large scale, and based upon some grand system or upon local interests, means retrogression; and that action of this kind that is motivated by latent distrust or hatred of the "foreigner" makes for a continuance of the old group hostility from which civilization claims to be emancipated. The fact that

freedom of trade is prized highly so long as it exists inside of national boundaries, however rude these may be, seems to indicate that hostility between political groups lies near the root of restriction. Freedom of trade is desirable as between Maine and California, Oregon and Florida, but not as between Maine and Canada, Florida and Jamaica, Texas and Mexico. Again, granted that certain new industries (fostered during their first years only) become strong and independent, it is but natural that fallible human judgment—even if sincere—shall have made its mistakes (cf. § 141). It is questionable whether favorable results of manipulation are not more than overbalanced by the calling into being of non-viable industries which may then prove to be a burden upon already thriving enterprises, and amount to a dead loss to the nation. What this means is that when human wits set themselves too confidently to work to “reorganize” some great social institution, their results can never in reason be expected to correspond to their intentions, however lofty and patriotic these latter may be. We do not advocate a let-alone policy,—such a policy, whatever its theoretic strength, is not fated to be put in execution, men being what they are,—but we do support the view that trade manipulation should be intelligent, careful, honest, non-political, and not based upon confused or irrelevant motives.

211. Mercantile creeds. Much of the elaboration of the present chapter’s topic is the function of the economist, but one other important type of trade control may be mentioned. This is found in the so-called Mercantile System, a combination of economic theory and practice dominant a century and a half ago, and even now unre-nounced, though no longer professed, in several of its aspects and precepts. Perhaps the crudest of the dogmas of this system was that which conceived a country’s wealth to be practically the same as its stock of precious metals, or, as it is more loosely put, which rested upon the identification of money and wealth. This has been called the “bullionist” policy. Assumed that that country is richest and most prosperous which could lay hand upon the greatest amount of the precious metals, the inevitable outcome was a manipulation of trade to secure the local presence of these desirable articles. Hence the struggle to possess a “favorable balance of trade,” that is, a surplus of exports over imports; for the difference in such a case must be paid in money by some ill-starred country into the treasury of the fortunate one. Naturally, again, if the fortunate exporting country could carry its own products, there was no call for an outflow of the metals to pay transportation charges. Here arose the distinction between “active” and “passive” commerce; those who delivered goods to the buyer and carried back what they themselves bought, possessed the former, while the sluggish customers who allowed goods to be brought to them were unenviable in that their trade was “passive.” These theories led out into applications and corollaries in the colonial

field, whereby colonies were obliged to occupy the unfavorable position in trade. The colony was to subserve the interests of the metropolis; hence it must raise what the latter desired, and must accept payment in what the latter produced. England, being a manufacturing country, therefore desired of the American colonies that they should raise the raw materials she needed and abstain from manufacturing even some of the least important articles. These would be furnished in payment for the raw materials of agriculture and of other extractive industries. Thus there would exist a desirable complementary relation between sections of the empire. Again, the carrying trade should be mainly in British hands, this forcing the colonies to remain relatively "passive." Such ideas were widely applied, as any treatise upon economic history would show. And there were other lesser applications of the Mercantile System that fall into line with those mentioned.

This system is now regarded in theory as antiquated and even ridiculous (cf. § 212). It met opposition and overthrow toward the end of the eighteenth century. It is scarcely a coincidence that the theoretical and the practical opposition to its doctrines and practices crystallized in the same year, 1776, which saw the publication of Smith's "Wealth of Nations" and the American Declaration of Independence. At any rate for England, which put the system into execution very rigorously, there resulted the loss of the Thirteen Colonies; and the opinion of competent scholars is that reaction against English attempts to control trade was prominent among the motives of revolt.

212. Trade policy lies in the folkways. The examples given of attempts to control the nature and paths of trade are perhaps sufficient to demonstrate the fact that exchange is not a thing light-heartedly to be tampered with. Trade can be helped or regulated, but only by actions radically based upon knowledge of its nature. It might here be stated that almost any consistent regulation is better than constant change in regulation; success in trade depends so largely upon accurate forecasting that any recurring interference with conditions causes miscalculations and loss, and the expectation of it induces a mood of timidity and hesitation. This is why trade, and business conditions in general, are commonly in a state of unrest every four years, and sometimes every two years, in the United States. Trade policy of some kind is generally behind our elections, and security is often threatened.

But, to return to the topic of the control of trade, there is yet a larger aspect from which it may be viewed. It could be shown that the various trade policies are entirely natural in the setting of their

time—indeed, are largely inevitable. For example, the monopoly system of the Dutch chartered companies was anything but palatable to the Netherlanders of 1600, for many distrusted and opposed monopolies. However, it was first of all necessary to accumulate capital for the East India projects, and in amounts hitherto unknown except in the hands of sovereigns, of whom the Dutch had none. It was likewise seen that the isolated smaller companies competed with each other in so destructive a manner that all profit was likely to be sacrificed. It was necessary to centralize and to give the dominant organization an exclusive title to its field. In other words, in the setting of its time the East India Company was inevitable. If, now, such an organization for the restraint of trade was thus inevitable in the evolution of trade, it seems in a sense futile to deprecate the tampering of man with these matters; in fact, this same tampering seems to be part of the evolutionary process.

This view of the matter falls in with the principles of human and social evolution with which we started (§§ 138–140). It has been seen that social evolution proceeds through the persistence or selection of variations in human action that have their seat in the brain. But the particular way in which a group sets out to react upon a certain problem of environment may or may not be rational (cf. § 141); certain classes may impose their unreason upon the policy of their times, as did the ecclesiastics of the Middle Ages. To secure the appropriate policies, therefore, is a matter of securing enlightenment and of proportioning the influence of classes. It is, above all, a matter of breadth of outlook, that the policy of the time may not reduce itself—as the tariff policy in this country has so often done—to a matter of interest-legislation. What is blameworthy in the past trade prescriptions is chiefly the result of ignorance and rapacity. Each nation that attained supremacy in trade acquired it through its adaptability to conditions, and through its resulting position as protagonist of a new age; and its decline from such eminence has been due very largely to stereotyped methods—in a word, to self-satisfied and ignorant maladaptability to a changing environment. But this too is natural in human affairs. A policy once found good, or thought to be good, is not lightly abandoned; inertia in the form of a conservatism that, rightly or wrongly, refers to the past for the justification of a persisting policy is wont to repress or deflect adaptive variations. We are here involved in the eternal tangle of social evolution—in the apparently senseless forward-pushings and hangings-back of the life of human society. Men pursue their real or supposed interests

in certain "ways"; if these cause too much discomfort, they turn to other "ways"; but the changing complexity of the motives and interests that move them renders an orderly evolution apparently impossible. All that can be said is that beyond their plannings and efforts lie the elemental forces which control all organic life, and which will enter at a crisis to exercise vigorous selection over both men and their ways.

Trade is in and controlled by these "folkways,"¹ and like the rest of its kind it is, within certain ranges, uncontrollable by the rational effort of man. Environmental conditions such as climate absolutely determine its form and movement. Man can exercise a considerable influence over its more local manifestations, but his efforts, in order to produce wholesome results, must take origin, not in religious or political prepossessions, but in expert knowledge of the subject. He can secure the best results by realizing the lasting limitations under which he must work and by falling in with the operation of natural law as he has come to see it through education and reason. There is no need of constantly repeating the errors of the past, of periodically reanimating long-exploded fallacies; if there are to be errors they should at least be new ones.

213. Summary of Part II. In recapitulation of the argument of the foregoing section of this book, we first introduce man as a special kind of animal, set down in an environment or in one of several types of environment (as described in Part I and amplified in Part II, Chapter VIII). Man was forced, along with other animals, to adapt himself to natural conditions. But, unlike the other animals, he possessed a specialized adjusting organ in the brain, and so not only escaped the need of constant bodily adaptation, but was enabled besides to spread over the earth as no other organic being, unendowed with his capacity of adaptation, could have done. Contact with different types of environment (climatic, organic, etc.) developed, notwithstanding, clearly marked types of efficiency in the struggle for existence, i.e. higher and lower types of civilization. But one of man's peculiar and characteristic adaptations calculated to ease the struggle for existence was developed in the form of group division of labor and function; and this naturally drew in its wake an inter-group exchange of products. Trade, largely supplanting war, rose up in all parts of the earth as a human habitude, and took on more effective forms as it became a settled institution. This agency naturally varied in its progress and

¹ For the nature of these factors of social evolution, see W. G. Sumner, *Folkways*.

character according as it was set in motion in one or another environment, physical or human (social). It began to function as a grand factor in the further development of the civilization with which it arose, and has acted as a sort of prerequisite for the evolution of the modern type of culture. It has been the object of much attention on the part of men, who, by their manipulations, have been able to alter its type and course to some degree, or even to thwart and ruin it in certain regions, or for a certain time. It is one of those great factors in human society which are conditioned ultimately in natural law; and the only chance man has of wholesomely "directing" it is to study its nature and remove such obstacles from its path as he can, basing his interference purely upon rational grounds, and exercising it with discrimination and tact.

We now pass on to the data of modern trade, out of which many of our foregoing principles and contentions are derived. We hope to be able to interpret or to suggest the interpretation of our commercial data in such manner as to leave them before the reader in the guise of something better than a mass of unrelated facts and figures.

PART III

GEOGRAPHY OF TRADE

INTRODUCTORY NOTE

We have seen in Part I the nature of the physical environment against which man is forced to react in the struggle for existence, while Part II has been concerned, in the main, with a discussion of the character of the responses made by man, under comparatively simple or primitive conditions, to one and another of the factors constituting the environment. There still remains to be considered the influence of these factors—physical, economic, political, and “human”—upon production and trade, under the complex conditions of modern civilization. It is a well-known fact that the elaborate industrial organization of the leading commercial nations of to-day has placed civilized man in a better adjustment to his environment than are his less advanced brethren in other parts of the earth. As a consequence of this, and of the complexity of personal and group relations in these days of great material development, the influences of the various factors affecting production and trade are less obvious and are harder to trace out than is the case under more primitive conditions where trade relations are reduced to their lowest terms. Nevertheless, it is the main contention here put forth that, even in our own day, man continues to be subject, in a greater or less degree, and always in the last analysis, to the various environmental influences with which he finds himself surrounded.

In no field of human activity are these of greater significance than in that of modern commerce, but, as a rule, they have failed of due appreciation. The idea of studying the streams of trade and their ultimate constituents in the light of the influences controlling them, rather than in the twilight of bald statistics, is a comparatively new one. Such being the case, it is in no way strange that the data so far accumulated for explaining the phenomena of production and

exchange are incomplete and inadequate. The study of definite regions of the earth, with the local human activities in view, is adding to the store of information already at hand; and, as time goes on, sufficient knowledge will be available, it is hoped, progressively to illuminate the field.

The present writers are not laboring under the impression that they—or anybody else—have traced out to completion all, or nearly all, the influences with which they or others might think it well to reckon in a treatment such as that which follows. A discussion of the leading facts and relations of modern trade is attempted, with such explanations and illustrations as seem necessary to keep the point of view of the authors continually before the reader—this is the object at which Part III is to aim. If the reader is a business man, doubtless many additional influences of the various environmental factors upon the matters under consideration will be suggested to his mind; while if he is a teacher with initiative, he will be able to lend additional interest to the day's assignment by comments and examples supplementary to the text. Of necessity, in such a comprehensive subject, considerable leeway must be given to the teacher; and this latitude we should not seek to abridge, even if it were practicable.

With regard to the method of treatment which we have followed, it will be observed that no attempt has been made to cover the whole field of trade nor to discuss all of the materials of commerce, as is the case with most of the text-books on commercial geography. Attention has been given, primarily, to the three great commercial nations,—the United States, the British Empire, and the German Empire. This field is sufficiently large to illustrate the fundamental principles upon which we believe the study of commercial geography should be based, and to yield a representative body of data on trade. Again, instead of discussing the distribution and production of commercial commodities first and then proceeding to deal with the various geographical divisions in order, it has been thought best to combine the two methods in one, treating each important product in detail under the particular country which leads in its production or, in some cases, in its elaboration. For obvious reasons this rule could not be adhered to strictly; consequently, if one country leads in only one or more commodities of a group, in some cases the other members of the same group are considered at the same time. Moreover, since the whole study is more or less centered around the United States, a tendency has been felt to treat as many topics as possible under this

country. It is hoped that such procedure has resulted in less repetition and in less scattering of material than has often been the case in the past. Finally, inasmuch as there are various materials of commerce — some of them of great importance — which are produced, either exclusively or predominantly, outside of the political limits of the United States or the British and German empires, there has been added a chapter in which some of the more important of these commodities could be treated.

THE UNITED STATES

CHAPTER XV

VEGETABLE PRODUCTS

214. Plant immigrants. The original distribution of those species of plants which have been domesticated by man was exceedingly unequal. The Old World and the New did not share alike (§§ 159, 160); of 247 different species studied by De Candolle, 199 were native to the former, 45 to the latter, and 3 were doubtful. Some countries, such as Patagonia and South Africa, seem not to have been the home of any of the cultivated plants. In the whole territory now included within the limits of the United States the only plants worth cultivating were the artichoke, pumpkin, and squash. Moreover, the only important cereal indigenous to the Americas was maize (cf. § 217), whose native habitat seems to have been in the highlands within the tropics whence its culture spread to the north and to the south. All the evidence points to its wide use by the aborigines long before the arrival of Columbus.

All of the cereals now so widely cultivated in the United States have therefore been introduced from abroad, and the same is true of a large proportion of the other cultivated plants. Excepting the forest trees, grasses, forage, and drug plants, the native flora of the United States have played but a small part in the material development of the country. At first the process of plant introduction was comparatively slow. The early Spanish, Dutch, English, and French settlers brought over a few species, and, in course of time as the necessity or opportunity arose, wheat, barley, oats, rice, cotton, hemp, flax, sugar cane, beans, cabbage, etc., were brought in and planted in an environment substantially the same in the case of each plant as the original habitat (§ 160). An adaptation to the changed conditions of soil and climate has resulted, in many instances, in an improvement on the original stock; but, even where this has not been the case, wide departures from the introduced types have resulted from the changed environment. Such excellence of results has attended

this work and so large has become the yearly production of this country's vegetable products that many persons forget that the wheat, corn, and tobacco belts are covered with a vegetation that is as truly descended from immigrant stock as are the planters themselves in those regions.

Nor has the work been completed ; it is now carried on, rather, in accordance with a thoroughly systematic plan. The federal government, through the Department of Agriculture, has come to the assistance of earlier individual undertakings. It has a division in the Bureau of Plant Industry, called " Foreign Seed and Plant Introduction," whose principal business is to seek out in foreign countries and replant here new varieties of our principal farm crops, as well as new species of vegetable products hitherto not grown in the United States. The various state experiment stations coöperate with the government in testing the adaptability of imported plants to the different agricultural regions of the country. Many attempts to naturalize new species fail ; many do not. The numerous varieties of soils (§ 72) and the wide ranges of temperature and rainfall in this country are distinct advantages in that they widen the possibilities of replanting successfully introduced species of every variety from the tropics to the cold temperate regions. Some recent successful accretions are durum wheat from Russia, the Smyrna fig, Kiusiu rice from Japan, the Corsican citron, and alfalfa from Turkestan and Arabia. Experiments now in progress bid fair to establish in the United States the growth of many other desirable food products hitherto associated only with foreign countries. The outcome of the efforts of all kinds to develop the country's agricultural resources is that the United States now leads the world in the annual value of farm crops produced, the yield being about 20 per cent of the world's total output.

In endeavoring to account for our preëminence in agriculture, a number of factors should be considered. Among these are the fertility of the various kinds of soils (Chapter III) ; the diversity of climatic conditions (Chapter V) making the successful culture of a great variety of crops possible ; the energy and resourcefulness of the population ; governmental activity and private initiative in the matter of scientific agriculture ; and the excellent facilities afforded for marketing the crops at home and abroad.

215. Leading farm products. In the United States, largely because of its high natural advantages, agriculture continues to be the dominant item of national wealth, although system and good business management are less highly developed in this occupation than in the other

great industries. Over one third of the labor force of the country is employed in this basic occupation. In 1907 the value of all farm products, at that point in production where they acquired commercial value, was \$7,412,000,000. This figure is 10 per cent greater than that for 1906, 17 per cent above 1905, and 20 per cent above 1904. A correspondingly large quantitative production has accompanied this rapid increase in the money value of agricultural products. Consequently, the problem of moving the crops to market has resulted, at times, in congesting the freight traffic of the railroads and steamships (cf. § 308). The leading crops of the United States with the approximate farm value of each for 1907, and the percentage which this figure shows above or below the average value for the previous five years, were as follows :

CROP	FARM VALUE (000,000 omitted)	Percentage above (+) or below (—) the average value for the previous five years
1. Corn	\$1,350	+26
2. Cotton (including seed)	675	+ 7
3. Hay	660	+20
4. Wheat	500	+ 5.5
5. Oats	360	+26
6. Potatoes	190	+26
7. Barley	115	+85
8. Tobacco	67	+16
9. Sugar beets ¹ and sugar cane	64	
10. Flaxseed	26	+ 3
11. Rye	23	+29
12. Rice	19	+36 ²
13. Buckwheat	10	+14
14. Hops	5	—29

CEREALS

216. Cereals in general. Among the great variety of food-stuffs for both man and beast the cereals occupy an important place. In general, they belong to the widely diffused grass family; many of them have been domesticated from very early times and some have never been found in a wild state. The most important cereals are maize, wheat, barley, oats, rye, rice, and sorghum (including the millets). Buckwheat, though not strictly a cereal, may for convenience be classed here. In the different countries one or more of

¹ The value of sugar beets alone was slightly above the figure for 1906 and 50 per cent above that for 1905.

² Thirty-six per cent above the average for the previous three years.

these constitute the staple diet of the masses. In China and Japan rice occupies first place, and the same is true of rye in northern Europe, and of wheat in Great Britain and the United States. From time immemorial the cereals have occupied the largest share of the land under cultivation. In 1908 the cereal yield of the United States was 4,329,000,000 bushels, having a value of \$2,694,000,000. The average yield during the previous five years was approximately the same, although the value for 1908 was 32 per cent above the average for the same period.¹

217. Maize. Maize,² or Indian corn, is known among botanists as *Zea Mays*, and is the grain of a large plant of the grass family, which is characterized by hollow stems and solid joints. A proof of its great antiquity in America is given by Darwin, who found, on the shores of Peru, ears of maize buried in the soil to a depth of 85 feet. Soon after the discovery of America the grain was introduced extensively into the Old World within the limits of climatic conditions necessary to its culture. But no country has, as yet, surpassed the United States in its production, nor, since its extensive cultivation in the United States following the early settlements, has any country been our serious rival.

This cereal is known under a variety of names. In America it is generally known as corn; in Great Britain it is called either maize or Indian corn; in Turkey, Egyptian corn; in Holland and Hungary, Turkish wheat; in central France, Spanish corn; in Egypt, Syrian durrha; and in South Africa, mealies.³ It should be remembered that there are numerous varieties of maize, over 300 in all. These vary in their chemical composition, some containing an abundance of starch, others of oil. They also differ greatly in the size, shape, and color of the kernel, the color varying from white to purple, while some varieties are even striped. All of these differences have been brought about by breeding and selection (§§ 157, 158), and by the diversity of environmental conditions under which growth for long centuries has taken place.

Maize is used as a food by both man and beast, but the greater proportion of the world's crop is used for stock feed. This is true especially in the United States where enormous quantities of fodder,

¹ The percentage area devoted to the production of each cereal, as shown by the twelfth census, may be seen by referring to the Appendix, Table I.

² Maize (Indian, *Mahiz*) is said to be an Arawak word, and so of South American origin.

³ Cf. Freeman and Chandler, *The World's Commercial Products*, p. 50.

of the raw grain, or of the manufactured corn meal are fed to cattle, hogs, and poultry. This is why the exports of corn are relatively so small as compared with wheat, in spite of so little being used as human food. Moreover, its low price per bushel compared with its weight tends to prevent its being sent to distant markets. Our corn exports, therefore, are largely in the form of meat products. The ears of the unripened corn of the sweet varieties, after being boiled, are used in this country as a table delicacy. In some lands, such as Mexico, Central America, Italy, and Egypt, maize is still used as the national food. In parts of Mexico it is ground in simple household mills and made into cakes called *tortillas*. In Italy a porridge called *polenta*, made from the poorly ground grain, is eaten as a regular part of the daily diet. In general, the most cultured people of the leading western nations prefer wheat to corn or rice as a staple breadstuff, and on account of the struggle for existence being less strenuous here than in such countries as China and India, they can afford to consume the more expensive cereal, wheat.

Among the important factors controlling the successful cultivation of corn are temperature, sunshine, rainfall, and soil.¹ The crop becomes a commercial success only when these factors are properly combined, and it is scarcely possible to state the influence of each. That of temperature is more or less indirect, but it makes itself most felt near the northern limits of successful culture, where, if it is too cold during the growing months, the plants will not mature. The yield per acre of corn is influenced greatly by the quantity and distribution of rainfall, the most favorable conditions being occasional heavy rains with much sunshiny weather intervening. The best soil for this crop is one which is drained easily and which does not bake in dry weather. While the above gives, in general, the climatic and soil requirements for a good yield of maize, it should be remembered that there are many types of the cereal which are adapted to an environment varying widely from the norm. Bearing this in mind, an examination of the extensive area in the United States east of the one-hundredth meridian with reference to soil and climate would show why such a large part of it is suited to corn culture (cf. §§ 61, 64).

The accompanying diagram (fig. 23), taken from the Statistical Atlas of the United States, 1903, shows, graphically, the enormous increase in production that has taken place in successive decades since 1850. The decrease between 1860 and 1870 is accounted for by the check to production caused primarily by the Civil War. In the fifty years

¹ For a full discussion, see Hunt, *The Cereals in America*, pp. 202-217.

following 1850 the increase of output was 350 per cent. Since the opening of the present century there has been no decline in the rate of increase. At the present day corn easily leads as our most valuable crop, as also in acreage and quantity produced. The principal corn-producing states are Kansas, Nebraska, Illinois, Iowa, Ohio, Indiana, and Missouri, and the territory included in these states may properly be called the *corn belt* (cf. § 72). Here two thirds of all the corn produced in the United States is raised; the average yield per acre is under thirty bushels. According to experiments made by the United States Department of Agriculture it seems possible, within a few years, to double the average yield per acre with little increase in work or expense. This will be done by better adapting particular varieties to the most suitable environment. It is in the southern states, where the present output per acre is small and where the growing season is not shortened by frosts, that the best field for

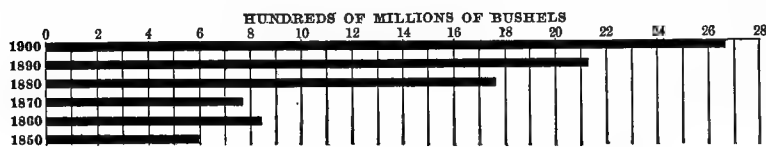


FIG. 23. Production of Corn in the United States, 1850-1900

expansion exists. The probable outcome of these experiments will be a selection of the areas best adapted to corn culture, and an abandonment of the others unless the demand is greatly increased.

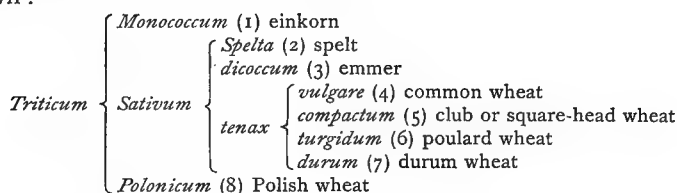
Although corn can be grown in many countries, its extensive cultivation is confined, at present, almost entirely to the United States, which yields four fifths of the world's crop. Argentina, Mexico, and the countries of southern Europe are the other largest producers. It is from Argentina that we may look for the greatest future foreign developments in the production of maize. Some even anticipate that, in the not distant future, Argentina will surpass the United States in yearly output.¹

218. Wheat. Botanically, wheat belongs to the grass family (§ 217); some very near relatives are rye, barley, and the noxious couch grass. Its original home is not known, but, with a reasonable degree of certainty, it was in central Asia, probably in the Euphrates valley. Its culture reaches back to prehistoric times, since grains of wheat have been found in the ruins of the lake dwellings of Switzerland. Other

¹ The average annual production of maize in bushels by continents from 1903 to 1907 inclusive is shown in the Appendix, Table II.

evidences of the great antiquity of its cultivation are that the Chinese were growing it as early as 2700 B.C.; that old manuscripts and legends have frequent references to the grain; and that different names for the commodity are found in the oldest languages.

Without going into the complicated question of the varieties of wheat, of which, by 1895, the United States Department of Agriculture alone had collected a thousand, it may be said that there are eight principal cultivated types.¹ The genus which includes them all is called *Triticum*, and the relationship of these types is here shown :



Einkorn is cultivated most commonly in Europe where other wheats will not flourish. It is used chiefly for mush and for cattle food rather than for bread. *Spelt* was the type extensively raised by the ancients, particularly by the Egyptians, Greeks, and Romans. Spain is about the only country in which this type is now raised; it is used for cattle feed. *Emmer* also has been cultivated from very early times, but now its production is somewhat limited. It is still grown, however, in parts of southern Europe as a summer crop. It is much more hardy than spelt, having great resistance power against drought and rust. The most unfavorable conditions of soil and climate produce a fair crop, although a dry prairie region with a hot short summer seems to be the most desirable environment. Consequently, emmer has been attracting considerable attention in the United States where it has become the object of successful experimentation. The possibilities of its profitable culture in the semi-arid regions of the Great Plains, in portions of North and South Dakota, where the commonly grown varieties often are damaged by early frosts in autumn or by late freezing in spring, are very promising (cf. § 43). *Common* wheat is the type best known to the masses, and is the kind that covers the greatest area in the wheat-growing regions of the world. *Club* or *square-head* wheat differs only in minor particulars from the common type. Its head is short and compact, and the straw short and stiff. These qualities enable it to withstand rough treatment either from the elements or during harvesting. It is grown in Chile, Turkestan, Abyssinia, and in the Rocky Mountain and Pacific Coast states of the United States. *Poulard* wheat is being experimented with in this country. Its culture, at present, is confined to the dry regions around the Mediterranean and Black seas. It is strikingly similar to the durum varieties, although botanically a distinct type. *Durum* wheat is a type introduced from Russia and Algeria. The experiments in connection with the seed brought from the former country seem most promising. Durum is known by many as

¹ See the discussion in Hunt, *The Cereals in America*, pp. 47-55, from which the table and many of the following facts are taken.

macaroni wheat, since, in Europe, great quantities of macaroni are manufactured from the durum; bread made from the flour of durum wheat has an agreeable flavor but a color somewhat resembling rye bread, and for this reason it is less desirable for flour, on account of long-established customs, than those wheats whose manufactured product makes a white bread. Experiments tend to establish the fact that the durum is peculiarly suited to the soil and climate of large areas of this country. They adapt themselves readily to regions of scanty rainfall, and are notoriously resistant to drought and heat. Durum is, therefore, a wheat for the dry lands where the common varieties grow poorly or not at all; its resistance against cold, however, is not so marked. If the soil is rich, the yield is prolific, and, in general, the crop is surer and the yield greater than is the case with our ordinary varieties. Moreover, the plant is less troubled by pests than are the common varieties. The extension of its culture in the United States should result in a great increase in the manufacture of macaroni and a corresponding decrease in the importation of this commodity. *Polish* wheat, resembling rye in general appearance, may have originated in Spain where it is cultivated extensively. The straw is almost solid and grows to a comparatively great height (4 to 5 feet). The yield is small and the grain is used chiefly for making macaroni. In several respects its life conditions resemble those of the durum — hence its adaptability to our arid regions.

Wheats are further classified as "soft" and "hard," "spring" and "winter," "red," "white," etc. In general, the soft kinds which contain a relatively large proportion of starch are used for making flour. Good results are often obtained at milling by mixing soft and hard wheats. The hard varieties are used much more for the manufacture of macaroni than for flour, being rich in gluten or proteid. All of the types of wheat described above, excepting emmer, have both spring and winter varieties. There is no hard-and-fast line, however, in this seasonal classification, for a winter wheat may be sown in spring with good results, and vice versa.

Introduced into the New World from the Old, the culture of wheat has spread so widely that to-day the United States leads in the annual production, the output being nearly one quarter of the world's total product. The census returns show that between 1850 and 1900 the increase in our wheat production was over 550 per cent. Europe, however, leads the continents in yearly output, yielding more than one half the world's total crop.¹

The largest yield of wheat in any single year in the United States was in 1901, when the total product aggregated 748,460,218 bushels. The yield for 1907 fell short of this figure by several millions of bushels, and it was 5 per cent less than the average yield for the previous five years. This enormous production is due to a combination

¹ The yield by continents and by countries is shown in the Appendix, Tables III and IV.

of causes, of which the most important are adaptability of soil and climate (cf. § 64), economical methods and the best machinery for farming, and the excellent organization of the service, though now somewhat inadequate, for marketing the raw or manufactured product.

The states which produce the greatest number of bushels are Minnesota, Kansas, North Dakota, Nebraska, Illinois, Washington, Indiana, South Dakota, Ohio, Pennsylvania, Missouri, California, and Oregon. Of these, the first nine (excluding Washington) grow nearly 60 per cent of the total yield and they may be said to represent the present interior wheat belt (cf. § 64). At the last census Minnesota, North Dakota, and South Dakota had the greatest per capita production (cf. § 43). In fact, in these states wheat was the leading agricultural product, although the yield per acre was only medium. The present center of wheat production is some distance west of Des Moines, Iowa; since 1850 it has moved westward nearly 700 miles and northward about 100 miles.

The wheat belt of the Pacific coast embraces the wheat-producing lands of California, Oregon, Washington, and northern Idaho. The grain grown in this section is different from that produced elsewhere in the country, being white and of a soft and starchy content. The conditions of soil and climate are such that other wheats, when grown in this habitat, lose their individuality in two or three seasons and take on all the characteristics of the standard white grain of this region.¹ This case alone affords a striking example of the effectiveness of environmental conditions in changing the character of a commercial plant.

Most countries do not produce sufficient wheat to meet the national demand; hence the international trade in this commodity and its manufactured products is large. Wheat may be sown both in spring and fall with good results. Fortunately, the geographical distribution of the great productive areas is confined neither to one continent nor to the northern or the southern hemisphere. Consequently, a wheat harvest, of greater or less extent, is being gathered each month of the year in some country or set of countries. This is shown by the following calendar:² In January, in Australasia, Chile, and Argentina; in February and March, east India and upper Egypt; in April, lower Egypt, Asia Minor, and Mexico; in May, Algeria, central Asia, China, Japan, and Texas; in June, Turkey, Spain, southern France, California, Tennessee, Virginia, Kentucky, Kansas, Utah, and Missouri;

¹ Holmes, *Wheat Growing in the Pacific Coast Region of the United States*, p. 20.

² This calendar is given in Edgar, *Story of a Grain of Wheat*, p. 191.

in July, Roumania, Austria-Hungary, southern Russia, Germany, Switzerland, France, southern England, Oregon, Nebraska, southern Minnesota, Wisconsin, Colorado, Washington, Iowa, Illinois, Indiana, Michigan, Ohio, New York, New England, and eastern Canada; in August, Holland, Belgium, Great Britain, Denmark, Poland, western Canada, and the Dakotas; in September and October, Scotland, Sweden, Norway, and northern Russia; in November, Peru and South Africa; in December, Burma and Argentina.

219. Oats. Oats belong to that tribe of the grass family known as *Avenæ*, a tribe distinct from the *Hordeæ*, to which wheat, rye, and barley belong. The plant has never been found in a wild state; moreover, all attempts to determine its native habitat have baffled the inquirer. De Candolle¹ believed that all the varieties of oats were derived from a prehistoric form which was a native of eastern temperate Europe and of Tartary in western Asia. Their earliest cultivation reaches back to prehistoric times, for oats have been found among the remains of the Swiss lake dwellings. It is believed, however, that they were not cultivated until long after wheat and barley, so that they played a smaller part in the earlier life of the human race than did these cereals.² They were grown little, if at all, in the Mediterranean region before the beginning of the Christian era.

Oats require for their best development a cooler climate than wheat or maize, together with considerable moisture. They are grown with good results in northwestern Canada in latitude 62° 30', and in Norway even as far north as 65°. Both the outward character of the plant and the seed, as well as the chemical composition of the latter, respond to the peculiar conditions of soil and climate in the regions where it is grown, or to breeding and selection. The continent which produces the greatest quantity of oats is Europe, because, on the whole, it satisfies better the peculiar climatic and other conditions necessary for the growth of this crop. In an average year its output is about two thirds of the world's crop.³

The country of largest production, however, is the United States, whose annual yield varies from about 7,000,000 to nearly 1,000,000,000 bushels. From 1850 to 1900 the increase was nearly 500 per cent. European Russia is a very close second, while Germany follows next in order with an average yield which is rather more than

¹ Origin of Cultivated Plants, p. 376.

² Hunt, The Cereals in America, p. 314.

³ The average annual production of oats in bushels, by continents, from 1903 to 1907 inclusive is shown in the Appendix, Table V.

one half that of the United States. The figures of the last census show that the principal oats-producing states are in the north. In fact, more than 95 per cent of the yearly output at that time grew north of the thirty-sixth parallel, and over 90 per cent in the North Central and North Atlantic States; Illinois and Iowa continue to be the largest producers.

This cereal is used for food both by man and beast, although, primarily, it is a stock food. For man it is used principally in the form of oatmeal, which is manufactured from the kiln-dried grain after removing the husks. The common use of oatmeal is a comparatively recent custom, a habit which doubtless has had a great deal to do with popularizing the present long list of "breakfast foods."

220. Sorghum. Sorghum includes a great variety of cultivated plants. Much confusion exists as to the names and classification of these; many of them are commonly known in the United States as millets. Hunt's classification¹ divides the sorghums into three groups: (1) The sweet or saccharine varieties, whose juice contains much sugar, known as sorghum (*Sorghum saccharatum*). These are cultivated either as forage plants or for making sirup, but they do not contain sufficient sugar to make their production for the latter purpose a profitable industry. (2) The non-saccharine varieties, which are cultivated primarily for their grain. They are also grown extensively as forage crops. Here are included Kafir corn, African millet, Indian millet, durrha, milo maize, Jerusalem corn, Guiana corn, and Egyptian rice corn. (3) A second group of non-saccharine plants, known as the broom corn varieties. They differ from the other sorghums in that their seed heads are much longer, straighter, and have stronger branches. This difference has been brought about consciously, by the process of selection, and the commercial value of the plant lies in this characteristic. The plant is cultivated for the "brush" or seed heads which are used in making brooms.

The native habitat of sorghum was probably tropical Africa. From here its culture spread into Egypt before the dawn of history. Later it was introduced into China.² It is a tall maize-like plant without ears, having a terminal head of small seeds. It is grown most profitably in a climate where the air is hot and dry. Kafir corn, for example, though usually grown as a substitute for maize, has numerous advantages over the latter in hot, dry regions. It is therefore specially adapted to those regions of the West where the maize crop is

¹ The Cereals in America, p. 382.

² De Candolle, Origin of Cultivated Plants, p. 382.

uncertain. Owing to the above conditions, its culture is spreading in the semi-arid regions of Kansas, Oklahoma, etc.

The seed of sorghum is smaller than the seed of the other cereals so far considered. It is commonly called millet, and is one of the cereals most widely employed as human food; it is estimated that one third of the people of the globe use it as a regular article of diet. Moreover, the extensive use of the crop for forage throughout the world should not be overlooked. No reliable statistics of the world's production are available.

Saccharine sorghum was introduced into the United States shortly after the middle of the nineteenth century. Kafir corn, a native of South Africa (hence its name), was introduced into this country in 1885 by the federal Department of Agriculture. It was first distributed widely in the southern states, but was raised with little success; soon it was tried farther north, with better results. Frequently the whole crop is used for fodder. The yield of seed is from 35 to 50 bushels per acre. Flour from Kafir corn is used to a limited extent, but the bread is rather inferior. Better results are obtained by mixing its flour with that of wheat for biscuits and pancakes. It is most widely used, however, in this country for forage; in 1899 the value of the forage crop (over \$5,000,000) was about seven times that of the grain product. The former is grown most extensively in Kansas, Texas, and Oklahoma; the latter, in the same states and California.

In 1899 broom corn was grown in 40 states and territories, although Illinois, Kansas, Missouri, Oklahoma, Nebraska, Texas, Iowa, California, and Tennessee produced 96 per cent of the total crop. Ten years earlier Illinois, Kansas, Nebraska, and Missouri raised 89 per cent of the whole. In 1899 over 90,000,000 pounds were produced in all, averaging 509 pounds per acre; the average price was 4 cents per pound. A ton of broom corn makes about 1200 brooms of the ordinary size.

HAY AND FORAGE CROPS

221. Hay. Under the general heading of Hay are included numerous "cured" crops used for feeding farm animals. Most of the plants cultivated for hay are grasses or legumes. Of these, the best known are timothy and several species of clover (*Trifolium*), such as common red, alsike, and crimson. Also many of the plants grown ordinarily for other purposes are often produced for hay; this is true of oats, barley, rye, etc. The first, if cut immediately after heading, makes excellent hay. Alfalfa (*Medicago sativa*) is rapidly coming into the

first rank both as a hay and as a forage crop. It is a leguminous perennial plant, native to western Asia, whose culture spread into western Europe. The Spaniards then brought it to Mexico, whence it found its way to the west coast of South America, and finally, in 1854, was brought to California from Chile. It seems to have been known and cultivated in the eastern part of the United States previous to this date, but, owing to poor results obtained, its production was unimportant. It is known as lucerne in the East and as alfalfa elsewhere in this country. The plant is especially adapted to irrigated lands; it has spread over the sub-humid areas of the Pacific coast and Rocky Mountain regions. Only in the West and Southwest has its culture reached any great proportions.

222. Forage. The term "forage" is used with a great variety of meanings. In its widest sense it includes all such animal foods as grain and root crops, as well as hay, straw, and ensilage. More properly, however, forage refers to a crop in which the whole plant, in a green state, is used for food. For example, oats would be considered a forage crop if cut green and fed without being cured; on the other hand, if after having ripened they were harvested and threshed, they would be called a cereal crop. Forage, as was seen in the case of hay, consists largely of grasses and legumes. Of the former, maize, Kafir corn, millet, oats, and barley are the most important; while the latter include alfalfa, soy beans, cowpeas, etc.

At present about 15 per cent of the improved lands of the United States are used for producing hay and forage, varying from 33 per cent in the North Atlantic States to 5 per cent in the South Atlantic division. Hay ranks third (cf. § 215) amongst the crops of the United States in farm value, being surpassed only by corn and cotton (including seed). During the past few years great changes have occurred in the hay and forage crops on account of the opening up of prairie lands hitherto unbroken. The further extension of the culture of alfalfa will greatly increase the production of hay and forage, for it often yields more than double the average crop of clover.

FIBERS

223. Introductory. It is necessary at the outset to distinguish between vegetable and animal fibers. A simple test may be made by burning the fabric: from the former a light, powder-like ash is left; a crisp coal from the latter. Animal fibers include wool and silk, and will be treated elsewhere (§§ 241, 363, 411). Vegetable fibers

are derived from hundreds of different kinds of plants, although the principal commercial ones are obtained from less than fifty cultivated varieties. The fibers that figure most extensively in the world's trade are comparatively few in number. They include the cottons, flax, hemp, jute, Manila, sisal, New Zealand hemp, Mauritius, istle, and ramie. For our purposes they may be classified conveniently as follows :

1. The cottons.
2. Soft fibers — flax, hemp, jute, and ramie.
3. Hard fibers — Manila, sisal, New Zealand hemp, istle, and Mauritius.

224. The cottons. The cotton of commerce is a comparatively short fiber, from one-half inch to two and one-half inches in length, borne on and surrounding the seeds of the plant, which are contained in pods or "bolls." These burst open at maturity. The seeds are brown or black and are about the size of small peas. The bolls are irregular in shape and vary greatly in size, those of medium dimensions requiring about seventy-five to make a pound of raw cotton. Under the microscope the fiber looks like a "collapsed fire hose, spirally twisted." Consequently, the separate lints naturally cling to each other, and can be made into a strong thread.

The cotton plant belongs to the mallow family (*Malvaceæ*); its near relatives are the common wild mallow and the golden hollyhock. The plants which bear the cotton fiber belong to the genus *Gossypium*, and they are either herbs, shrubs, or small trees. The difference in size is the least important distinction from a commercial point of view, for the really important differences are in the fineness, length, strength, and color of the fiber. Originally the cottons probably were perennial. Now they are commonly cultivated as annuals, even where the climatic conditions are not sufficiently severe to kill the plants in winter. A great deal of confusion exists regarding the proper botanical classification of cottons. This is due both to an imperfect knowledge of various original species and to the fact that the cotton plant responds quickly to a changed environment. De Candolle¹ notes more than three distinct species, yet he discusses only *Gossypium herbaceum*, *G. arboreum*, and *G. barbadense*. The same three classes are recognized by Linnaeus. The first of these species is mentioned by De Candolle as probably native to India. It is impossible to say when its culture began. To Alexander the Great is ascribed the spread of cotton culture from Asia into the Mediterranean countries

¹ Origin of Cultivated Plants, pp. 402-411.

of Europe where it was grown before the opening of the Christian era. The circumstances connected with its transfer to America are not known. This introduced species, however, is the one most extensively cultivated in the United States to-day under the name of American upland cotton. *G. arboreum*, or tree cotton, was native to tropical Africa, probably upper Egypt. Since linen was the most commonly used textile during the early Egyptian civilization, the inference is that cotton was not cultivated at an early date in Egypt. The third species, *G. barbadense*, or Barbados cotton, was a native of the New World, but exactly where the plant was indigenous is a matter of conjecture. Some writers mention Mexico, others the West Indies. When America was discovered the Indians were cultivating and using the cotton plant over an extensive area stretching from Mexico to Brazil, and from the West Indies to Peru.

From the practical standpoint of both the producer of the raw commodity and of the manufacturer there are to-day five types of cotton. These are American upland, sea-island, Egyptian, Indian, and Peruvian. This list, it is to be remembered, includes only the well-recognized types. Many interesting and promising results have been obtained by crossing various of the above varieties.

225. American upland cotton. This is the kind most extensively raised in the United States and, consequently, the variety that figures most widely in the world's trade. As already mentioned, De Candolle regards it as probably introduced here from Asia via Europe. Some writers, however, consider it as a descendant from a New World species.¹ The same species is now cultivated successfully in Persia, India, Russian Turkestan, Brazil, and Puerto Rico. In the United States cotton was first grown in Virginia, towards the close of the first quarter of the eighteenth century. Its culture was confined almost entirely to that state and the Carolinas until about the year 1800. The growth of the industry was very slow. In the earlier history of its production the fibers were separated from the seeds by hand; the invention of the cotton gin by Eli Whitney, in 1794, greatly stimulated the industry. The same is true of the inventions made a few years earlier in Great Britain by Hargreaves, Arkwright, and others.

The world's cotton crop in recent years has been between 17 and 21 million bales of 500 pounds each. The United States contributes, roughly, two thirds of this amount; British India and Egypt rank

¹ Hunt, Forage and Fiber Crops in America, p. 326; Freeman and Chandler, The World's Commercial Products, p. 331.

second and third respectively, the three countries producing about nine tenths of the world's crop.¹

The development of cotton production in the United States since 1790 is shown in the table below.² The cotton belt of the United States (fig. 24) is about 1450 miles long (east to west) and, approximately, 500 miles in width, and includes all of the southeastern states from North Carolina to Texas inclusive. Practically the whole upland crop grows in the region south of the 37th parallel and east of the 100th meridian (cf. § 64). Of the 448,000,000 acres included in

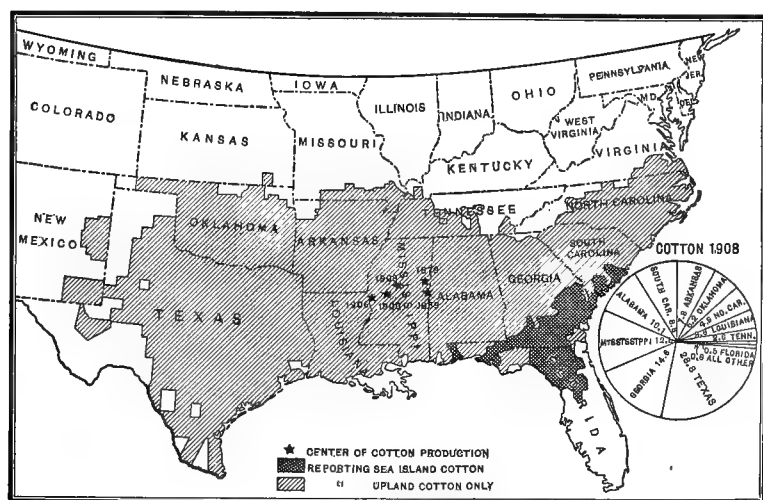


FIG. 24. Cotton-producing Areas of the United States
(After Map in *Bulletin No. 100*, United States Bureau of the Census)

this area, only about 1 in 17 is devoted to cotton. Not only is it possible to increase the cotton acreage considerably, but, by giving attention to the selection of seed, fertilization, and cultivation, the possibilities of swelling the total crop are enormous. The regions

¹ Figures showing the cotton yield by countries are found in the Appendix, Table VI.

² Cotton production for stated years, 1790 to 1906:

Year	Bales of 500 pounds each	Year	Bales of 500 pounds each
1790	4,000	1859	4,482,111
1800	96,000	1869	2,747,845
1810	160,000	1879	5,214,355
1820	360,000	1889	7,128,775
1830	708,494	1899	9,052,015
1840	1,288,334	1905	10,575,017
1849	2,002,230	1906	13,273,809

of greatest production are, chiefly, the alluvial area of the Mississippi valley and eastern Texas and scattered portions of South Carolina, Georgia, Alabama, and Louisiana. The percentage of the total crop grown in each state is shown by the diagram on the map (fig. 24).

226. Sea-island cotton. This plant is a native of the New World, and it is the *Gossypium barbadense* of botanists (cf. § 224). Its fiber surpasses that of all other cottons in length, fineness, and value; hence quality rather than quantity determines its commercial importance. The supply is limited, and during the last few years the average annual production has been under 100,000 bales, or less than 1 per cent of the total cotton crop of the United States. As a result of recent expert scientific investigation it is believed that not only may its production be greatly increased, but that its quality also may be still further improved.

The finest staple is grown on the sea islands, chiefly John, James, Edisto, and Wadmalaw, along the coast of South Carolina (cf. § 62). In Georgia and Florida the coastal counties produce scarcely any cotton, this being due largely to the unfavorable character of the country and the consequent predominance of other industries. The interior counties of both these states yield large quantities of sea-island cotton; they produce also a good deal of the upland type. Although the crop of sea-island cotton varies greatly in different years, on an average Georgia produces approximately 50,000, Florida 33,000, and South Carolina 11,000 bales.

Most of the sea-island cotton is grown on that type of soil known as "Norfolk fine sand." Humidity exercises a considerable influence upon the quality of the staple; those fields on the sea islands which have an ocean exposure are said to yield a staple exceptionally fine and glossy on account of the damp winds. Much care has to be exercised in planting upland and sea-island cotton together, lest the superior qualities of the latter be weakened by hybridization. However, good results have been obtained by carefully selecting and propagating certain promising hybrids. The type known as long-staple upland is a derivative of sea-island¹ obtained in this way. It is cultivated with good results in the rich alluvial soil of the Yazoo delta in Mississippi, as also in many of the other states in the cotton belt.

227. Other kinds of cotton. *Egyptian cotton*, also, is believed to be a derivative of the sea-island type which has become modified considerably in a changed environment. It should be remembered, however, that indigenous varieties were grown in Egypt centuries ago, although systematic production did not begin

¹ L. H. Dewey, Principal Commercial Plant Fibers.

until about 1820 when the present variety was introduced. The peculiar character of its fiber, which, in commercial value, stands midway between sea-island and long-staple upland, makes it especially adapted to the manufacture of hosiery and mercerized goods. This is why we import Egyptian cotton to the value of \$10,000,000 yearly. At present this variety of cotton is grown exclusively in Egypt, but experiments made by the United States Department of Agriculture (cf. § 214) have established the practicability of growing it successfully in various parts of the South. Planters, however, are prejudiced against it, owing to the small size of its bolls as compared with upland types; moreover, manufacturers will hesitate for a long time to take up the use of this staple when derived from any other region than Egypt.

Indian cotton is a native of southern Asia. The plant itself differs from American upland in that the stem is more slender and less woody than the latter and the bolls are smaller and more nearly spherical. The fiber is coarse and short, ranging from a half inch to an inch in length, making it less desirable than American upland. Of some varieties the lint is glossy white; of others it is yellow or even golden brown. When exported it is used for coarse yarns and for mixing with other varieties of cotton; the imports into the United States are unimportant.

Peruvian cotton is often called kidney cotton from the fact that the seeds in each of the three divisions of the boll cling together into a more or less kidney-shaped mass. The seeds are black and the fiber is shorter, coarser, and more wiry than that of American upland. In some instances it closely resembles wool. Moreover, the lint varies greatly in color, ranging from white to brown. This type of cotton is cultivated for commercial purposes chiefly in Brazil and Peru, although it is found in Central America, the Philippines, and in various tropical islands in the Pacific. When imported into this country the South American cotton is used chiefly for mixing with wool.

SOFT FIBERS

The soft fibers, including flax, hemp, jute, and ramie, are often called bast fibers. This is because the fiber consists of the bast or inner and fibrous portion of the bark. In general, they are flexible and of soft texture, consisting of many overlapping cells borne in the inner bark of the plants.

228. Flax. The flax plant (*Linum usitatissimum*) is an annual whose native habitat was probably in western Asia between the Caspian Sea and the Persian Gulf. According to De Candolle, this plant replaced an earlier perennial type that was cultivated in Switzerland and northern Italy by the lake dwellers before they knew the use of hemp. It appears to have grown wild south of the Alps. The succeeding annual was introduced into northern Europe by the Finns, and into other parts of Europe by the western Aryans; doubtless the Phœnicians also spread its culture here and there in their travels.

Flax was one of the earliest plants cultivated for fiber, and from the very beginning of authentic records until the use of cotton became common in the nineteenth century, flax was employed more extensively for fabrics than any other vegetable fiber. The ancient Egyptians and the Hebrews made common use of linen. The flax plant is found among ancient Egyptian drawings, and the bandages encircling the mummies are said to be mainly of linen.

It should be remembered at the outset that this plant is the source of two distinct commercial raw products of great value, namely, the fiber and the seed. The former is obtained from the stalk or straw and is noted for its strength, firmness, and length, varying from 1 to 3 feet. There is little or no foundation for the popular belief that the best fiber is in the lower stem or root.¹ The seed is extremely rich in oil (linseed) which has superior drying qualities, making it a valuable ingredient of paint and varnish. It also figures extensively in the manufacture of oilcloth, printer's ink, and patent leather. It seems impracticable to get from one crop both the best seed and the most valuable straw. When the plant is cultivated for the fiber, from 2 to 4 bushels of seed per acre should be sown; the crop must then be harvested by pulling the plant up by the roots before the seeds are fully ripe. This both impairs the quality of the seed and reduces the quantity. On the other hand, when the plant is to be grown primarily for the seed, but one half to three quarters of a bushel of seed to the acre should be sown, and the crop may be reaped; this method of culture will result in an increased output of seed, but the straw will be too coarse to yield a good fiber. Consequently, as a business undertaking, flax is generally raised the world over either for the fiber or for the seed. In the European countries the former is the primary object; in the United States the latter is the prevailing motive of culture.

Flax was one of the first agricultural products to be introduced into the New World. There are records of its being cultivated within a few years after the settlement of Plymouth. It was introduced originally solely for its fiber. The invention of the cotton gin in 1794 was followed by the introduction of cheap cotton, which soon began to supplant linen; consequently, a check was given to the production of flax for fiber in the United States, and soon its cultivation for the seed began. This movement has continued until to-day this country vies with Argentina for the first place among the flaxseed

¹ Bolley, "Flax Culture," in *Farmers' Bulletin No. 274*, 1907, p. 24, United States Department of Agriculture.

producers in the world.¹ Shortly afterwards the manufacture of linseed oil was commenced; and by 1810 there were 283 small linseed-oil mills in the United States, 171 of which were in Pennsylvania.

Flax culture in this country has never been followed up according to scientific methods. The scene of its production has continually shifted, each community sooner or later abandoning it as a regular crop, in full assurance that it was exhausting to the soil. Experimentation has clearly shown this to be a fallacy; the real cause for the degeneration of the crop after the first year is the presence in the soil of microorganisms. The most deadly of these is called *Fusarium lini*, which is introduced into the soil primarily by the seed; if the latter is treated by the formaldehyde method, the disease will be prevented, provided the soil is not already infected. The crop grows best in the cooler parts of the temperate zone. In general, so far as the seed crop is concerned, the climatic and other conditions best suited to its culture are similar to those best adapted to successful spring-wheat cultivation; and it is significant that the areas of largest production in this country are found in the wheat belt of the Middle West.

Since the production of flax for fiber is now practically unknown in this country, the various processes involved in harvesting the crop and in separating the fiber from the straw will be discussed elsewhere (§ 406). As will then be seen, the production of flax for the fiber calls for an intensive system of culture, and the separation of the fiber from the straw requires hand labor disagreeable to the last degree. "The reason why the American farmer does not produce flax fiber is not to be found in any obstacles from climate or physical conditions. His labor would yield as much flax, absolutely, as that of the European cultivator. He simply finds that his labor yields more in other branches of agriculture."² Besides, our farm laborers are so accustomed to the extensive system of cultivation and to the use of machinery that they shrink from adapting themselves to the methods necessary for the successful production of the crop for the fiber.³ Here we have a case of the human or "habit" element.

HARD FIBERS

The principal hard fibers, including Manila, sisal, New Zealand hemp, istle, and Mauritius, are often called leaf fibers in that they

¹ See the figures for flaxseed production in the Appendix, Table VII.

² Taussig, *The Tariff History of the United States*, pp. 406-407.

³ For further discussion of the soft fibers, see §§ 376, 406, 407, 408.

are borne in the tissue of the leaf or leaf stem. They are comparatively long, varying from 1 to 12 feet in length. In general, they are stiff and woody, and are less flexible than the soft or bast fibers.¹

FORESTS

229. Introductory. A country which has extensive forest areas is at a great advantage in the struggle for existence (cf. §§ 149, 155, 194). This is because no other part of his environment has been more extensively utilized by man or has entered more intimately into his life economy. Even our remote ancestors found their homes already provided for them in the trees; and locomotion was made easy, owing to the possibility of swinging from one branch to another. For primitive man the forests were a ready source from which food and shelter could be provided; even the scanty clothing of some tribes was made from the bark of certain trees (cf. § 155). The development of the art of navigation was largely conditioned upon the use of wood or bark to provide the vehicle of transportation (cf. § 292). In fact, in all stages of civilization, from the lowest to the highest, man has depended upon the forest environment to satisfy many of his diversified wants. As a source of supply for fuel and light, wood is now less indispensable than in times past when coal, oil, and natural gas were unknown, but at present it is the only fuel used in many countries. Until comparatively recent times lumber and its finished products were the chief source of building materials for houses, barns, factories, offices, wharves, ships, etc.—in a word, of many of the visible signs of material progress.

The greater quantity of commercial forest products is obtained from the extensive forests of the north temperate zone, which stretch from the arctic circle to the thirtieth parallel, although the tropical and subtropical regions furnish numerous woods of peculiar value for less general purposes than those subserved by the woods of the North. The United States was bountifully supplied by nature with the most useful and staple varieties of trees. This has been one of the strongest factors contributing to the great material progress of the nation in the nineteenth century. At the present day we are the foremost wood-producing country in the world, Canada and Russia being our principal rivals. Roughly, the timbered areas of the United States are found in several groups of states of which the following are important to note: (1) the Northeastern; (2) Southern; (3) Great

¹ For a discussion of the hard fibers, see §§ 323, 369, 376, 409, 410.

Lakes ; (4) Rocky Mountain ; (5) Pacific. Conifers and hard woods predominate in the first three fields ; conifers alone in the others. At present spruce, white pine, hemlock, and various hard woods, notably hickory, oak, and maple, are found in the first group. Four general types of forest prevail in the Southern States, varying, roughly speaking, with the altitude. Cypress and hard woods are found throughout the swamps and the lower sections of the river valleys of the Atlantic and Gulf coasts. The balance of the coastal plain from Virginia to Texas was originally forested with yellow pine. The lower slopes of the Appalachians and the encircling plateau are covered with hard woods, while higher up on the mountains are conifers, of which spruce, white pine, and hemlock predominate. The southern part of the Great Lakes region contains considerable hard wood. In the northern section pine, tamarack, cedar, and hemlock occur. Western yellow and lodgepole pine are the chief timber trees of the Rocky Mountain forests, while in the Pacific States is found an abundance of Douglas fir, hemlock, pine, cedar, and redwood (cf. § 68).

230. Annual output of forest products. The present yearly drain upon our forests for commercial purposes is shown by the following table compiled by the United States Forest Service.

ANNUAL OUTPUT OF FOREST PRODUCTS	QUANTITY	VALUE
Lumber (board feet)	35,000,000,000	\$560,000,000
Firewood (cords)	100,000,000	350,000,000
Shingles and laths		30,000,000
Hewed crossties	70,000,000	30,000,000
Cooperage stock		25,000,000
Turpentine and rosin		25,000,000
Pulp wood (cords)	3,000,000	15,000,000
Timber exported (unsawed)		10,000,000
Mine timbers, posts, poles, and other products		30,000,000
Total		\$1,075,000,000

The above represents no less than 50,000,000,000 board feet. It does not take into account the enormous quantity of wood consumed locally for fuel and other domestic purposes, nor of the depletion of extensive areas by fire. Taking into consideration all the possible drains upon the forests, it has been stated by forest experts as a conservative estimate that our present annual consumption of wood in all forms amounts to at least 100,000,000,000 board feet.

The center of the lumbering business has shifted greatly during the past fifty years. Until then it was carried on near the banks of rivers or streams, and the small sawmill run by water power furnished

the sole means of manufacture. Gradually the forests adjacent to the rivers became exhausted ; but the coming into prominence of a new power, steam, soon made it possible to carry on the lumbering industry in the interior, and before long it became concentrated around large plants where all the economies of large-scale production could be applied. Until 1850 the largest percentage of lumber produced in the United States came from the Northeastern States, prominent among which were Maine and New York, but to-day pulp wood is the only important product of this region. By 1850 the white pine areas of the Great Lakes section had been entered, although their greatest exploitation did not take place until the decade 1870 to 1880. The Southern States are now the greatest contributors to the lumber output, yielding annually nearly one third of the whole. The indications are that these fields have about reached the top crest of the wave and already the Pacific States are coming into prominence. Thus it is seen that practically all of the virgin forests, excepting those in the Rocky Mountain section, have been or are being exploited, although, as yet, not to the point of exhaustion. The shifting character of the lumbering business is well brought out by the following table, compiled by the federal Forest Service, which shows in ten-year periods the percentage of the total cut furnished by the principal fields.

Year	Northeastern States	Great Lakes States	Southern States	Pacific States
1850	54.5	6.4	13.8	3.9
1860	36.2	13.6	16.5	6.2
1870	36.8	24.4	9.4	3.8
1880	24.8	33.4	11.9	3.5
1890	18.4	36.3	15.9	7.3
1900	16.0	27.4	25.2	9.6
1905	14.6	20.4	27.9	13.8

Thus it appears that the Northeastern States, which a little over half a century ago produced more than one half of all the lumber, now contribute less than one sixth of the whole, and the decrease has been steady. On the other hand, the remaining fields here considered have increased their relative outputs fairly steadily, although their combined cut is not 10 per cent greater relatively than was the cut in the northeastern field alone at the middle of the last century.

The shifting of the lumbering business from one part of the country to another has resulted in a marked change in the nature of the output. White pine used to make up one half of the total products, but now it is only about one tenth. The following seven species

furnish over four fifths of the whole cut: yellow pine, Douglas fir, white pine, hemlock, oak, spruce, and western pine. The states which are the largest individual producers are Washington, Louisiana, Wisconsin, and Michigan.

231. Danger of a timber famine. The danger of a timber famine in the near future is being seriously felt, and this is due largely to the wastefulness of the past and present generations. This is why so much interest is being taken at the present time in forestry and in the conservation of our forest resources. There is no way of determining the actual amount of stumpage that still remains, but the best authorities estimate it at from 1400 to 2000 billion board feet. With an annual consumption of 100 billion feet (§ 230),—and disregarding the growth in the meantime, which is not over one third of the yearly cut,—the supply would become exhausted in from 14 to 20 years. Taking this into account, and on the assumption that the same forest policy will be pursued in the future as in the past, the day when our forests will be exhausted is put off for no more than a few years. It is safe to say that such will not be the case, for the United States Forest Service is carrying on a successful educational campaign to secure greater care in handling the timber lands. Furthermore, as a safeguard for future generations against forest exhaustion, the federal government has deemed it wise to go into the lumber business. It has acquired vast stretches of timber lands known as "national forests." These are administered by the Forest Service, and it is about them as a center that the excellent work of this branch of the government is being carried on. National forests now embrace about 160,000,000 acres, of which all but a few million are in the United States proper, the rest being in Alaska and Puerto Rico. As yet they are contributing very little to the timber output, for two thirds of their stumpage is in the Pacific States region where the private-owned timber lands are meeting the market demands.

It should not be overlooked that the presence or absence of forests has an important bearing upon the whole question of inland navigation. If the area drained by a river and its tributaries is denuded of forests, the water flow will be uneven (cf. § 83). The streams will be raging torrents during the rainy periods and dry, or nearly so, the rest of the time. Moreover, erosion will be at a maximum (§ 80). To maintain a navigable channel in such cases, great expense has to be incurred in taking out the detritus and in providing water of sufficient depth in the dry seasons. The maximum equality of flow is desired in any good water-ways policy. A dense growth of vegetation

over the drainage area is the best means of securing an even flow, and to this end the forest is the best agent. The leaves tend to regulate the speed with which the water reaches the ground, and the humus of the soil has a great absorbing capacity. A large percentage of the rain thus is stored in the ground and finds its way gradually to the sea. Thus it can readily be seen that the depletion of our forest areas would greatly increase the problem of developing our inland-water navigation (§§ 308, 309, 310).

TOBACCO, FRUITS, AND VEGETABLES

232. Tobacco. Tobacco is prepared by curing the leaves of certain species of the *Nicotina*. The one most usually cultivated, and from which most of the world's annual crop of tobacco is obtained, is *N. tabacum*, an annual plant which grows to the height of from 4 to 6 feet, and produces several clusters of beautiful pink flowers. This plant was native to the New World; its original home was Ecuador and neighboring countries, possibly extending as far north as Mexico. When America was discovered the use of tobacco in some form was common from Canada to Patagonia. In several parts of South America the usual method of consumption was by chewing and snuff taking; while in North America smoking was universal, and the indications are that the practice was very ancient. Numerous pipes of almost unsurpassed workmanship have been unearthed from various North American tombs and mounds, or have been found in the possession of existing peoples. The use of tobacco, especially for smoking, was intimately bound up with the most solemn rites and ceremonies of the aborigines; it was also commonly used in their social and commercial relations.

Another species, *N. rustica*, quite unlike *tabacum*, was commonly cultivated by the native tribes in Mexico and farther north. Its native habitat seems to have been in Mexico or Texas, possibly in California. The plant bears pale yellow or green flowers, and the tobacco made from it is coarse. Introduced into the Old World, this species is now the source of the Hungarian tobaccos and much of the East Indian leaf. The finest tobacco in the world, according to some experts, is the mild Persian variety called Shiraz. It is obtained from another species, *N. persica*. The latter is regarded by many as a variety of *N. tabacum*. At any rate, it is not an Asiatic species but probably was introduced into Persia through the seeds of a South American plant. Of the numerous species of *Nicotina* the three here described include practically all of the sources of commercial tobaccos.

The plant was introduced into Europe from America in 1558 by a physician named Francisco Fernandez, who had been sent by Philip II of Spain to examine the flora of Mexico. For some time afterwards it was used chiefly as a medicinal herb; the English seem to have been the first Europeans to take up the practice of smoking. This was towards the close of the sixteenth century, and during the next hundred years the habit spread widely among all nations (cf. § 154).

The world's annual production of tobacco is about 2,500,000,000 pounds, nearly all countries contributing to a greater or less extent. The United States grows more tobacco than any other country and, with its possessions, produces nearly one third of the total crop.

As already mentioned, tobacco had long been grown by the natives of America. When the earlier European settlers arrived they soon took up its cultivation, especially in Virginia and Maryland. The commodity was so closely wrapped up with the life economy of the colonists that, in some cases, it was used as money, being legal tender for all debts including customs dues and the salaries of officials and ministers of the gospel. As early as 1619, 20,000 pounds were shipped to England from Virginia in a single year. An export tax on tobacco was imposed by the mother country, and in 1676 it totaled £120,000. By 1691 the yield of Virginia and Maryland alone was 36,000,000 pounds. From this time on its culture spread rapidly and its relative importance as a commercial crop steadily increased; in 1790 tobacco stood second only to flour in the list of exports, constituting nearly 22 per cent of their total value.

Though tobacco was early grown in Pennsylvania and New England, the first real extension of the industry was westward in Kentucky and Tennessee. In the northern portion of the former state and in southern Ohio considerable tobacco was grown as early as 1785, although it was not until about 1810 that the industry came into prominence in central and southern Kentucky and Tennessee. Foreign shipments were made, for the most part, and nearly up to the middle of the century, by boat through New Orleans. Up to 1860 Virginia continued to be the leading state in production, but the Civil War dealt a serious blow to her agriculture, and the tobacco crop was among those most affected. Tobacco is now being grown in twenty-five or more states of the Union. Kentucky easily leads, producing over one third of the entire crop of the United States.¹

¹ Table VIII in the Appendix shows the acreage, production, and farm value of this crop in the principal tobacco-producing states.

The principal varieties of tobacco grown in this country are the *cigar* types for the domestic trade ; the *manufacturing* types for domestic use in smoking and chewing ; the *bright yellow* for cigarettes, pipe tobacco, and plug wrappers ; *white burley* for smoking and chewing, in both the domestic and export trade, and the *export* types, entirely unsuited to our tastes. The most important purchasers of our tobacco in the order of quantity consumed are Great Britain, Germany, Italy, Canada, Spain, Austria, and Switzerland. Great Britain takes only our best leaf, for which she is required to pay a high price. The leaf must be large, olive green, and so cured that the odor of hard wood is still present. In a similar way each of the other countries to which our tobaccos are sent have certain peculiar demands as to color, flavor, etc., which must be catered to. Consequently, the value of our tobacco crop is, to a large degree, dependent upon the ability of the growers to produce types conforming closely to the market requirements for each grade. Here we find a striking example of the "human" element as a factor in production and trade.

In this connection it should be noted that no other general farm crop is grown under a more intensive system of cultivation than is tobacco ; the industry also has become highly specialized, and an effort is made to produce a tobacco whose qualities conform to a certain specific use. The tobacco plant is highly sensitive, and the environment of soil and climate has a marked influence upon the flavor and quality of the leaf ; thus in such a famous tobacco region as Cuba, leaf of good quality cannot be grown close to the ocean even though the soil is all that could be desired. The same is true in Sumatra, although the climatic conditions, in their variation from the ideal types of a favorable environment, are too delicate to be detected by meteorological instruments.¹ On the other hand, a type of soil which yields a heavy tobacco is entirely unsuited to the production of a fine variety. A clayey soil, which retains much moisture, tends to produce large plants, the leaves of which when cured are dark brown or red. But a light sandy soil gives a thin delicate leaf, curable to a bright red mahogany or fine yellow color. In a word, so marked is the influence of soil upon the quality of the tobacco that soils of different types, though only a few feet apart, produce entirely different grades of tobacco. Much care must also be exercised in selecting the seed for any particular crop.

¹ Whitney, "Tobacco Soils," *Farmers' Bulletin No. 83*, 1898, p. 8, United States Department of Agriculture.

The federal government, through the Bureau of Plant Industry in the Department of Agriculture, is doing a valuable service to the country in its tobacco investigations.¹ These are centered around such problems as the improvement of the quality and yield of old types; the production of new ones, by the processes of seed selection and breeding, better adapted to the soil and climatic conditions of the leading tobacco areas; and the economizing of fertilizers. The experiments made are promising, and recently several new varieties have been produced and grown with good results. To the end of saving considerable cost in fertilizing the crops, a winter legume, called hairy vetch, is sown for a cover crop. This not only adds to the nitrogen content of the soil, but it enables the plant to withstand drought, excessive rainfall, and other unfavorable conditions better than where no cover crop is grown.

233. Fruits and vegetables. No attempt will be made to more than outline briefly the circumstances connected with the origin and growth of the fruit and vegetable industries of this country, owing to lack of authentic data. Most of these plants were not natives but were brought in from time to time (cf. § 214). In some localities, however, the aborigines were bountifully supplied by nature with wild grapes, berries, and nuts; these were used in season and dried for winter use. The Spaniards under Menendez are credited with being the first white men to plant fruit trees in North America, they having started an orange grove at St. Augustine, Florida, in the middle of the sixteenth century. The early Jesuit fathers are said to have planted pears in the Great Lakes region at about the same time. Apples also were introduced at an early date, but until the middle of the nineteenth century they were grown almost exclusively for cider making.

It is only within the last fifty or sixty years that fruits and vegetables have been raised for commercial purposes. Until then they were produced solely for home consumption and were consumed only in season. Gradually some of the larger northern cities having steamboat or railway connections with near-by farming districts began to be supplied with fresh garden truck. Soon a taste was acquired for fruits and vegetables out of season, and the development of the country's transportation facilities and improved means of handling goods in transit, notably refrigeration, made possible the shipping of

¹ Previous to July 1, 1907, the Bureau of Soils carried on investigations of tobacco, but on that date all tobacco work in the Department was, in accordance with an act of Congress, taken over by the Bureau of Plant Industry.

perishable commodities over long distances. Large areas in different parts of the country were given over entirely to the production of garden crops. This was true particularly of many of the southern states and it led to a complete revolution in farming conditions in many districts. In such regions the production of the older staple crops has been given up and efforts are now concentrated upon supplying northern markets with fresh fruits and vegetables. This has reacted upon the value of land in truck-farming districts. Farms on the southern Atlantic seaboard which previously were worth from \$2 to \$5 per acre have, since truck farming has been introduced, risen in value to from \$40 to \$500 per acre, the figure depending upon their situation with reference to the markets.

The steamship lines were the pioneers in carrying garden crops from southern ports to northern cities. The first regular consignment was made in 1847 when a small quantity of lettuce, radishes, mint, and strawberries was brought to New York. It was not until the spring of 1885 that the first all-rail shipment of garden truck was made to New York from the South. The first carload of oranges from Florida reached New York in October, 1888, and of strawberries in March of the following year. From these beginnings has developed the enormous business of to-day, which gives employment to thousands of men and involves the expenditure of millions of dollars each year.¹

The Census of 1900 was the first that made any serious attempt to secure definite reports of the value of our fruits. The total annual product was appraised at over \$131,000,000. The leading fruit states in value of output, and the percentage of the total crop contributed by each were as follows: California, 21.5; New York, 12.1; Pennsylvania, 7.5; Ohio, 6.8; Michigan, 4.5; total, 52.4. The same census showed that 5,750,000 acres of land in the United States were used for raising vegetables; this was 2 per cent of the acreage of all farm crops. The potato was the most important vegetable produced; over one half of the total acreage of vegetable crops was given over to potatoes, and the value of this crop was over 40 per cent of the value of all vegetables raised.

¹ For the development of refrigeration, see § 235.

CHAPTER XVI

ANIMAL PRODUCTS

234. Introductory. We have seen (§§ 157, 159) that man, in his occupation of large parts of the earth's surface, has modified considerably the distribution and original character of many plants of the vegetable world. Certain species have been destroyed or displaced by others, the better to satisfy his diversified wants in the struggle for existence. Those which he has domesticated make more or less specific requirements of soil and climate the conditions of their best growth, while the areas over which they can be raised with profit are well defined geographically.

In a similar way the animals are influenced by the physical environment, and have been subjected to striking modifications in their nature and general life conditions at the will of man. The climate of a given region places a limit to the areas over which a species may range. For example, the reindeer could no more be suited to the tropical jungle than the tiger to the open arctic regions. Again, the topography and vegetation are important considerations in the distribution of animal life. The wild horse and antelope are adapted to the open plains, wild sheep and goats to inaccessible crags on high mountains, while numerous species of animals require the food and protection afforded by a forest environment to suit their best needs.

Among primitive peoples the game in the forest was a constant source of food supply, and often this was the only purpose that the animals served. The food thus acquired, added to the roots and herbs daily gathered, made up the regular bill of fare. Such conditions of life set a limit to population and to advancement in the arts. Not until man began to domesticate animals and plants and have societies of other species than his own about him, could any considerable progress be made beyond the savage state. But when this was done his resources were greatly increased, capital could be accumulated, and the way was opened up, in one important direction, for progress towards civilization.

Owing to the uneven distribution of domesticable animals, the opportunity afforded for proceeding along the paths of culture varied

greatly in different parts of the world. For instance, it is of considerable interest to know that the only animal form native to the New World that has come into common use over an extensive area is the turkey, though it remained for the Europeans to tame it. Soon after the discovery of America the turkey was taken to Europe, whence, after domestication, it was reintroduced into this country. To be sure, the Indians trained the llama and alpaca as beasts of burden, but they were of no more than local importance. In the plant world as well they were handicapped, owing to the lack of available species upon which to work (cf. §§ 159, 214). It may have been that the limitations thus imposed upon the Indians in the matter of domestication account, in part at least, for their never getting much beyond the savage stage. The Old World, on the other hand, was the native habitat of most of our domestic animals, and the work of taming them was done, in a large degree, by the Aryan races. Moreover, it is an interesting fact that in Europe and Asia, where the horse, ass, camel, elephant, etc., existed in a wild state, i.e. where domestication was possible, the human race made the most rapid advances toward civilization (§§ 160, 166). The fact that the different species of domesticable animals were adapted to different climatic and topographic areas has enabled man, in many instances, to reduce the natural disadvantages of many regions.

As men have advanced in the scale of civilization they have learned to make new use of animals and their products. Probably their chief as well as their original use has always been for food; and cattle, sheep, swine, goats, and poultry form the principal source. Many species have been made to draw or carry heavy burdens, notably the horse, camel, donkey, elephant, and reindeer. The skins of a great variety of animals are used as clothing and for various other purposes (§ 155). Under modern slaughtering conditions scarcely any part of the animal goes to waste. The bones and horns are converted into combs, buttons, and fertilizer; the hair is used for felt or for mixing with lime for plastering; hogs' bristles go into brushes; while fats and oils, in great variety, swell the long list of secondary products.

235. Refrigeration. Within comparatively recent times new processes of preserving meats and other perishable commodities have been discovered, so that the world's trade in them has been greatly increased. Some such devices have been known from very ancient times. For example, the American Indians used to cut meat in strips and dry it in the sun, thus carrying over a food supply from time of plenty to time of scarcity; this was called "jerked" meat. In modern

times the chief method of preservation has been refrigeration, a device practiced only since about 1875. The excellent manner in which both rail and water transportation companies now handle shipments of chilled or frozen meats and other perishable commodities is a matter of common knowledge. The first refrigerator cars were made by remodeling ordinary freight cars; double floors, roofs, and sides were provided, and the space between was packed with sawdust. The loaded car was provided with a large ice box, the water from the melting ice passing off to the ground through a hole cut in the bottom of the car. Under such conditions the first shipment of refrigerated dressed beef was made from Chicago to Jersey City in the seventies. Whether the preserving method be by refrigeration, pickling, canning, smoking, or otherwise, the common aim is to bring about unfavorable life conditions for the bacteria of putrefaction.

236. Domestication and breeding. Man has changed the domestic animals considerably by breeding them (cf. §§ 158, 159). Experimentation of a strictly scientific character in this direction has not been carried to as great perfection, perhaps, with the larger and more expensive animals as with smaller and quick-breeding species such as mice and guinea-pigs; but great improvements have been brought about by selection and by crossing the different breeds to get certain desirable qualities. In this way, as has been seen, horses are bred for speed or for draft purposes; cows for milk or flesh; sheep for length and fineness of wool or for size of body, and so on. Again, the adoption of scientific principles in feeding live stock has resulted in a marked improvement in their general character.

The most advanced nations have made careful studies of the diseases prevalent among domestic animals with a view to eventually stamping them out (cf. § 150); already considerable progress has been made, but a great deal more remains to be done. The Bureau of Animal Industry in the federal Department of Agriculture in this country is doing good work along these lines, and the results obtained from the investigations and experiments are published and circulated widely among farmers and stock-owners. By an act of Congress of June 30, 1906, provision was made for the inspection of the carcasses of cattle, sheep, swine, and goats prepared for human consumption and designed for interstate or foreign commerce. Those found to be diseased or otherwise unfit for human food are destroyed; the sanitation of slaughtering establishments is also provided for. A permanent appropriation of \$3,000,000 per year is set aside for the expense of administering the law.

237. Animal foods and pasturage. The best conditions for a large output of animal food products are a temperate climate, good and sufficient pasturage, and enough capital at the command of the producers to avail themselves of the economies connected with the industry. Where the climate is too cold it becomes necessary to provide shelter for the animals and to practice winter feeding, both of which add considerably to the cost of production. The pasture land must be accessible to market. With the improvement of agriculture and the increase in population of a region, lands hitherto available for pasturage soon become too expensive for this purpose, and the stock raiser is compelled to go farther away for a cattle range or to occupy the high-priced lands. If he chooses the latter alternative, he must produce a grade of meat so far above the average that its increased selling price may offset the extra cost of production due to the rise in value of the land. Moreover, the production of good meat and of a uniform quality, and the economical delivery of the animals to slaughtering centers require a highly organized industrial system and financial strength on the part of the producers.¹

238. Distribution of world's meat animals. The world's great market for animal food products is Europe. Three regions surpass all others as sources of supply: the United States, Argentina, and Australasia. The first supplies chiefly cured pork, lard, and fresh beef; Argentina, fresh beef and mutton; while Australasia's principal contribution is frozen mutton. An investigation was made in 1907 by the Bureau of Statistics of our federal Department of Agriculture regarding the number of the principal meat animals in the world by countries. The estimate was as follows:

Sheep		609,806,860
Cattle		424,499,238
Swine		141,327,595
Goats		91,151,486

Argentina leads with 19.7 per cent of the world's sheep, and Australia comes second with 12.2 per cent. Next in order are European Russia (9.7 per cent), United States (8.8 per cent), Asiatic Turkey (7.4 per cent), and the United Kingdom (4.8 per cent). Regarding cattle, British India takes first place with 20.9 per cent of the whole number, closely followed by the United States with 17.5 per cent. The only other countries having more than 5 per cent are European Russia (8.8), Argentina (7.1), and Brazil (7.1). The United States

¹ *Bulletin No. 40*, p. 6, Bureau of Statistics, United States Department of Agriculture.

figures prominently in the number of swine, having 40.1 per cent of the whole. Germany is the second country in order of importance, with 13.4 per cent. Austria-Hungary follows with 9 per cent, European Russia with 8.4 per cent, and France with 5.4 per cent. British India is the great goat-raising country, having 31 per cent of all. The only other countries raising the animal in considerable numbers are Asiatic Turkey, South Africa, Mexico, and Algeria, contributing, respectively, 9.9, 7.9, 4.6, and 4.4 per cent of the world's supply. The United States occupies a minor place in goat production, for we have but 2.2 per cent of the total number.

The value of the cattle, sheep, swine, and goats on farms and ranges in the United States in 1907 was, approximately, \$2,152,-000,000. This, however, is less than one third the value of the farm crops in a single year (cf. § 215), and only twice the value of the corn alone. Cattle constitute by far the largest item, their aggregate value being about \$1,527,000,000; the value of the dairy cows being one third and of other cattle two thirds of the whole. Swine come second in order, the figure being \$418,000,000. Sheep and goats are placed at \$204,000,000 and \$3,000,000 respectively.

239. Cattle. History records that the Spaniards introduced neat cattle into Mexico about 1525 from the West Indies, where they had been brought by Columbus. They multiplied rapidly and soon roamed widely over the excellent feeding grounds to the north and east. Then the English, Dutch, and other colonists from northern Europe brought over their own breeds, from which have descended the greater number of the cattle found in the United States. For a long time little attention was paid to the purity of the stock, but early in the nineteenth century considerable attention was given to breeding. In this country cattle are now raised chiefly for beef and dairy products; their production for draft purposes, hides, and tallow, which are the primary motives in some countries, is secondary here. The center of the cattle-raising industry has shifted greatly since the middle of the nineteenth century. In 1850 the states which led in number of cattle were, with one exception (Ohio), still on the Atlantic seaboard. They were, in order, New York, Ohio, Pennsylvania, Georgia, and Florida, each having over 1,000,000 cattle. By 1900, 18 states and territories had at least this number, but the greatest producers were much farther west: Texas, Iowa, Kansas, Nebraska, Illinois, and Montana, in order, were the leaders. New York had fallen to the seventh position, Ohio ninth, and Pennsylvania tenth. Thus it is seen that the greatest development has been in states which formerly were waste lands. The

production of large herds of cattle requires, as already pointed out, extensive grazing areas, which in the older and more densely populated regions are now utilized for other purposes. But, for still another reason, it was inevitable that the center of the cattle-raising industry should shift westward, and the movement has not stopped as yet. The best environment for cattle in this country is found in the states included in the Great Plains (cf. § 65), for here are found the choicest grazing lands in the United States. Moreover, the farmer is restrained from competing with the grazer since, owing to the deficient rainfall, these lands cannot be utilized for agriculture excepting to a limited degree (cf. § 65).

In many parts of the country cattle are kept essentially for the production of milk, butter, and cheese. Since milk is a perishable commodity, it is necessary that the herds of cows which supply cities and villages with it be comparatively near the market, so that for short distances wagons, and for longer distances special trains, can distribute the daily supply. The centers of butter and cheese production need not be so near the market. At the Census of 1900, 50 per cent of the dairy cows were in the North Central States, and 20 per cent in the North Atlantic States, i.e. near large centers of population. At every census year since 1850, excepting 1890, New York state has had the greatest number of milch cows, while, from every point of view, it is the leading dairy state. In the North Atlantic States dairying is the principal source of income on a large percentage of the farms where cows are kept. On the other hand, in spite of the large dairy herds in the central West, other branches of farming are the main stay of the owners.

240. Swine. The early colonists introduced swine of an inferior grade into this country. By a process of careful breeding, selection, and feeding, great improvements from the original stock have resulted. Some of the first swine breeders' associations were formed between 1875 and 1890, showing that it was not until the last quarter of the nineteenth century that anything more than local or individual efforts to improve the swine were made.

As already pointed out (§ 238), we lead the world easily in swine production. Though they are raised in greater or less numbers in all parts of the country, the great swine region of the United States and of the world is in the territory included in the states of Iowa, Illinois, Nebraska, Missouri, Indiana, Texas, Kansas, and Ohio.¹ This group of states (excepting Texas) is the identical group in which two thirds

¹ The order here given represents the order of production.

of our enormous corn crop is raised (cf. § 217). Corn being the chief food for swine, it is only natural that the corn belt and the swine-producing areas should coincide. Nearly one half of the corn crop is fed to the hogs and goes to the market chiefly in the form of ham and bacon ; and a large percentage of the rest is consumed by other domestic animals, so that the export of corn, as such, is comparatively small (cf. § 217).

241. Sheep and wool. The Spaniards and the English figured most prominently in introducing sheep into this country. The former are credited with bringing them to Mexico and Florida in the sixteenth century, and from these importations large flocks sprang up later, especially in Texas, Utah, and New Mexico. It is probable that the type of animal introduced by the Spaniards was the *churro*, or common sheep, rather than the *merino*. The English brought sheep to Virginia as early as 1609, and from this time on they were introduced rapidly into most of the other colonies, the stock being from those types common to England in the seventeenth century. At the beginning of the nineteenth century the sheep found along the Atlantic coast, as far south as Georgia and as far west as the English-speaking settlers had gone, were descendants of various English breeds and of the long-wooled type. In Georgia, the states bordering the Gulf of Mexico, and westward to the Pacific Ocean the Spanish sheep prevailed. What few merinos there were, were confined to the North Atlantic States.

In order that wool of best quality might be available for home manufactures, 26,000 Spanish merino sheep were imported in 1810 and distributed throughout the country. The fact that this breed can do well even upon the coarsest food makes it easily adaptable to an environment unfavorable for less hardy breeds. Owing to the industrial depression in this country in 1815-1816, following the close of the Napoleonic wars, wool could not be marketed and entire flocks of merinos were slaughtered. With the revival of manufactures after 1820 there came a demand for an even finer grade of wool than before, so that Saxony merinos were imported during 1820-1823. But their physical weakness and the general decline in the value of wool prevented this breed from gaining a strong foothold in the United States. About the middle of the century came the transition from fine-wool to coarse-wool and mutton sheep (cf. § 158). For the past ten years or more there has been a marked tendency to increase the mutton breeds, this being especially marked in the states east of the Mississippi where, with the growth of population, the demand for

meat is great. The wool clip is about 300,000,000 pounds annually; practically all of it is consumed at home as well as more than one half this weight of imported fiber, which generally is finer than our domestic product. Montana, Wyoming, Idaho, and Oregon are the chief wool-producing states.

The movement of the sheep industry from the east and south to the far west is well brought out by the following table, compiled by the federal Census Bureau. It shows, by geographical divisions, the distribution of sheep by percentages in 1860, 1880, 1890, and 1900.

GEOGRAPHIC DIVISIONS	1860	1880	1890	1900
North Atlantic States	26.4	11.8	10.1	6.3
South Atlantic States	11.9	6.1	6.0	4.3
North Central States	35.6	32.4	30.2	25.2
South Central States	16.8	15.2	17.2	8.3
Western States	9.3	34.5	36.5	55.7
Hawaii				0.2
Total	100.0	100.0	100.0	100.0

At the time of the last census the seven states and territories having more than 3,000,000 sheep and lambs were all in the western division excepting Ohio.

242. Goats and mohair. The Angora goat, a native of Asia Minor, was introduced into the United States in 1849 by Dr. James B. Davis, of Columbia, South Carolina, who had been sent to Turkey at the request of the Sultan to experiment in cotton culture. Upon leaving Turkey, Dr. Davis was presented with nine Angora goats, and it is from these and a few others imported from South Africa that have descended the two million or more goats found widely scattered throughout the country. From these small beginnings it is believed that a large industry may eventually develop.

The Angora goat will flourish in a region where the temperature, whether hot or cold, either remains fairly steady throughout the year, or where there are great extremes. The amount of moisture in the air is the most important climatic factor to consider in dealing with these animals. As their native habitat was high up in the mountains where the air contained little moisture, high altitudes are preferable; wet and marshy lands are not at all suitable. This animal has many uses. "The fleece, called mohair, furnishes some of the finest of fabrics among ladies' goods and is used in various other manufactures; their habit of browsing enables the farmer in a wooded locality to use them to help in subjugating the forests; their flesh is exceedingly delicate and nutritious; the milk, though not as abundant as with the milch breed of goats, is richer than cow's milk; their tanned skins, though inferior in quality to the skins of the common goat, are used for leather; their pelts make the neatest of rugs and robes; they are excellent pets for children; a few of them in a flock of sheep are a protection from wolves and dogs."¹

¹ Thompson, "The Angora Goat," *Farmers' Bulletin No. 137*, p. 12, United States Department of Agriculture.

243. Horses. Horses were introduced into Florida in 1527 and into some of the North Atlantic seaboard states early in the seventeenth century. From these early importations the greater number of the common farm and trucking varieties have descended, although the stock has been crossed at frequent intervals with some of the best breeds of the Old World. Improvements in the means of transportation have, at times, stimulated the demand for horses, while in other instances (e.g. the development of trolleys) a tendency in the opposite direction may be traced. In general, however, the great economic development made possible by improvements in the art of locomotion has led to the utilization of horses for many purposes hitherto unknown. To supply the growing demands of both home and foreign markets for our cereals, as well as to insure sufficient food for all kinds of domestic animals, an increasing supply of horses and mules is required to cultivate the land. Moreover, the exportation of horses to foreign countries has increased rapidly during the past fifteen years, 3226 being exported in 1892 and over 80,000 per year by the opening of the twentieth century. The number of horses in the United States at the present time is nearly 20,000,000 with an approximate value of \$1,867,530,000. The farmers and ranchmen of the Western States raise more horses for market than those in any other part of the country, and the two most important horse markets are Omaha and Kansas City, both of which are near the center of the greatest horse-raising area. In some of the Southern States mules are more numerous than horses, for the latter cannot endure the hot, moist climate and hard usage as well as the former.

244. Poultry and eggs. The various species of poultry found on the farms of this country, such as chickens, ducks, geese, and turkeys, are, with the exception of the latter, immigrants from the Old World. The common domestic fowl, popularly designated chicken, is the most numerous and important species. It was domesticated in very early times, is of Asiatic origin, and was introduced into this country by the earliest colonists. Except for a few fancy breeds, poultry is kept as a food supply.

Until comparatively recent times the raising of poultry was not a distinct industry, but rather a side issue in general farming. Various causes have combined to give rise to the new occupation of poultry-keeper. Among these, the excellent results that can be obtained by adopting careful breeding and scientific feeding methods, and the ever-widening market due to modern methods of preserving and

transporting the output of the poultry farms are important considerations. Moreover, quick returns are realized upon the small amount of capital invested, and when the business is intelligently and carefully conducted, it is remunerative. The successful poultry raiser must learn to cater to the peculiar fancies of different markets. In certain cities brown eggs are in demand and command the highest price, while in others white eggs are the fashion. Similarly, fowls dressed by "dry picking" are at a premium in some localities where "scalded" ones will not sell at all, and vice versa. Here is illustrated the "human" element as a factor in trade.

From the nature of the industry, poultry and eggs are likely to be raised to a greater or less extent in all sections of the country. Still there is a noticeable tendency towards localization which is easily explained. Corn is the best cereal for fattening poultry, and to save transportation charges the poultry-raising business, like flax culture and swine raising, is settling down in the corn belt. One half of the poultry produced in the United States is raised in the North Central States; also 55 per cent of the eggs come from the same region. The value of the poultry raised per year is about \$140,000,000 and of eggs \$150,000,000. The former is consumed largely in the home market, while our foreign shipments of eggs vary from less than \$500,000 to \$1,500,000 per annum.

FISHERIES

245. Introductory. It is clear that the influence of environment is a matter of comparatively slight significance in the fisheries of a country; for, excepting the fisheries of rivers and lakes, they vary in importance with the proximity of the fishing grounds and are not referable directly to the country itself. Still the nature of the coast line and of the region directly back of it have an important bearing upon the subject; for if the coast is broken and dotted with good harbors and the back country comparatively barren, the inhabitants, of necessity, are forced to the sea either to fish or to engage directly in commerce (cf. Norway and Nova Scotia). Religious persuasions have had an important bearing upon the trade in fish, in that certain varieties of fish are, regularly or periodically, in great demand in the West Indies and in the Catholic countries of Europe. Again, it should not be overlooked that the fisheries of a nation have a more or less intimate bearing upon its merchant and naval marines.

Under the head of Fisheries are included not only the fish used as food but the commercial products derived from all marine animals.

The fish which are staple articles of diet as well as those considered as luxuries are comparatively well known. The number of purposes, other than for food, for which water fauna are utilized is often underestimated.¹ Such products may be classified conveniently as follows: oils, fats, and waxes; fertilizers; furs and leather; shells, bones, and ivory; and miscellaneous articles such as glue, isinglass, and sponges. It is estimated that the value of the world's annual production of such commodities is \$45,000,000, of which the United States contributes one fourth. The oils are less in demand than formerly, owing to the competition of mineral oils (cf. § 264). Time was, however, when whale oil was of great commercial importance, and from 1820 to 1860 whale fishing was one of the principal American industries, and 70,000 persons looked to it for a livelihood. At the present day the seal fisheries of the northern seas are made lucrative by the oil obtained from the blubber underneath the skins of the animals, as well as by the furs. Moreover, great quantities of oil useful for medicinal and other purposes are derived from the cod. Spermaceti, a wax-like substance, is obtained in refining sperm oil and is used in making candles and ointments. The sperm whale also yields from its intestines a substance called ambergris, which is now used chiefly in preparing perfumery. Shells, seaweed, and non-edible fish, notably the menhaden, are employed as fertilizers. One half of the world's fur and fully three fourths of all the fur produced in the United States come from such sea animals as the seal, mink, and otter. Leather is manufactured from the skins of most aquatic mammals, and also from other marine species. Among the hard substances derived from fish, shells are the most important, having an annual value of upwards of \$7,000,000, and pearls have nearly an equal value. Whalebone is obtained in smaller quantities than formerly, the United States contributing about five sixths of the annual output. As the available supply has diminished, it has increased greatly in price. Sponges to the value of \$5,000,000 are marketed each year, the areas off the coast of Florida producing one tenth of the supply. Thousands of dollars' worth of glue, derived from the parts of fish formerly considered as useless, are used on postage stamps and labels, for court-plaster, and so on.

The two most important areas from which the fish utilized for food are obtained are the waters of western Europe, with the North Sea as a center, and the western Atlantic around the coasts of Newfoundland,

¹ See article by C. H. Stevenson on "Aquatic Products in Arts and Industries" in *Report of United States Commission of Fish and Fisheries*, 1902, pp. 179-279.

Nova Scotia, New Brunswick, Prince Edward Island, Quebec, and the New England and Middle Atlantic states. Yet there are many other lake, river, and sea fishing grounds, especially in the temperate and arctic regions, so that fishing is carried on more or less extensively by many countries. By international agreement each nation reserves for its own fishermen exclusive privileges within three miles of its coasts ; beyond that limit the field is open to all comers.

The fishing industry of the United States surpasses that of every other country in the world. The United Kingdom and Russia stand high in the list, while Japan, France, Canada, and Norway are next in order. There are abundant resources in our lakes, rivers, coast waters, and along the shores. Moreover, the Grand Banks of Newfoundland and St. George's shoals, two of the most famous cod-fishing regions, are easily accessible. Our commercial fisheries, excluding the island possessions, yield an annual income of nearly \$60,000,000, distributed, territorially, as shown in the Appendix.¹

246. North Atlantic States. From the above-mentioned table it is seen that this group of states leads in the value of commercial fish products. New Jersey and New York, in order, are the greatest contributors. The former is very favorably situated for carrying on an extensive fishing industry, there being good transportation facilities for marketing the products in New York, Philadelphia, Jersey City, and numerous other large cities. The state fronts on New York and Delaware bays and on the Hudson and Delaware rivers, so that both fresh and salt-water fishing can be carried on throughout the year. In addition to the cod and other offshore fish that are caught, large numbers of shad, bluefish, and oysters are taken. Oysters represent 50 per cent of the value of the fisheries of New York state, but bluefish, menhaden, clams, and scallops are of considerable importance. For the whole group of states the fishery yielding the largest income is the oyster ; in fact, we produce nearly 90 per cent of the world's supply. Shad, menhaden, clams, and bluefish are the other largest items.

247. New England States. Massachusetts surpasses all the other states of this group both in the quantity and in the value of the fishing products. In the latter respect Connecticut stands second and Maine third. The most important species taken are cod, haddock, hake, pollock, halibut, mackerel, herring, and oysters. The latter have an annual value of nearly \$4,000,000, and the output of Connecticut makes up three fourths of this amount. Gloucester is the

¹ Table IX.

greatest fishing port in the Union, having upwards of 6000 people engaged in the work. Over 170,000,000 pounds of fish were landed at the two ports, Gloucester and Boston, in 1906, with a value of \$4,070,000; three fourths of the catch was made directly off the New England coast. In these two cities are located numerous wholesale houses engaged in the sea-food industry. The Maine coast, with its many indentations and islands, is well adapted to the life of the fisherman; and its rocky shores favor the breeding of lobsters, which represent the most important fishery in the state.

248. Alaska. There are numerous varieties of fish in the Alaskan waters, but, although considerable attention is being given to the development of other fishery resources, salmon, cod, and halibut are the principal species caught. The salmon industry of the waters of south and southeastern Alaska, notably the Yukon River, became important about 1885, and it has grown to such proportions that a large percentage of the salmon product of the United States now comes from this region. As early as 1878 attempts at canning salmon were begun by the establishment, near Sitka, of a factory owned by a San Francisco firm. Soon others were started, and by 1907 there were 48 plants in operation. Other methods of preserving the fish, such as pickling, dry salting, smoking, and freezing, are practiced extensively. Cod fishing is carried on under the direction of firms and individuals having headquarters in San Francisco, Seattle, Anacortes, and Tacoma, where the catch is sent and prepared for market. A large proportion of the output goes to the West Indies, but the price obtained is less than that for the Atlantic cod, owing to the fish not being cured dry enough to stand the southern climate; efforts are being made, however, to do away with this defect. Halibut are obtained chiefly in the numerous bays, sounds, and straits of southeastern Alaska. In the summer the fish scatter considerably, but during the winter they collect in schools on the banks, at which time the greater part of the year's catch is made.

The Pribilof Islands, in Bering Strait, are the breeding ground of the largest fur-seal herd in the world. Since Alaska was purchased in 1867, the United States government has received a revenue of over \$9,000,000 for the lease of the privilege of taking seals in these waters—a sum greater than was paid for all Alaska. The lessee, at present, is the North American Commercial Company, whose contract expires in 1910. Not more than 15,000 skins may be taken each year, and the company pays at the rate of a little over \$10 for each skin.

249. Pacific Coast States. The waters of the Pacific coast abound in numerous varieties of fish such as are found, in general, at the same latitude on the Atlantic, namely, cod, herring, halibut, etc. Salmon in great varieties are obtained from the rivers, and the canned product finds a ready market in England as well as in all parts of the United States. Salted cod supplies the home market, and many carloads are sent to Chicago and cities farther east. Refrigerator cars carry large shipments of fresh sea food to interior points in Colorado, Nevada, New Mexico, and Arizona. Shad, striped bass, German carp, and catfish have been introduced into the Pacific waters in recent years; the fisheries of Washington contribute the greatest amount towards the value of the total yearly output of these waters.

250. Gulf States. The value of Florida's fisheries exceeds that of all the other Gulf States, representing more than one third of the total figure.¹ Louisiana and Mississippi come next in order. Four items make up nearly two thirds of the value of the annual output, namely, the oyster, mullet, sponge, and shrimp. The oyster fishery is carried on extensively in all the states, and the yield is worth over \$1,250,000 a year.

251. South Atlantic States. North Carolina leads in this group of states in the extent of the fisheries. In 1902 the value of the output in this state alone was \$1,739,661 as compared with a total of \$2,849,663 for the whole group. The six varieties having an annual value of more than \$100,000 were, in order, the oyster, mullet, shad, trout, striped bass, and clam.

252. Great Lakes. Ten years ago the fisheries of Lake Erie were more valuable than those of any of the other lakes; at the present time, however, Lake Michigan leads with nearly one half the value of the total output. Lake Ontario's product is comparatively unimportant. In 1880 the whitefish was more abundant in the Great Lakes than any other species, but now herring has taken first place, although the supply seems to be diminishing. Trout is the next item in value, followed by yellow perch, whitefish, and blue pike.

253. Mississippi River and tributaries. The fisheries of this section are carried on in seventeen states, and Illinois leads with about one third of the value of the total product. The most valuable species taken are catfish, German carp, black bass, and fresh-water drum, although numerous others are important. Great quantities of pearl buttons are manufactured from the shells of mussels taken from the Mississippi River.

¹ This refers only to the western coast of Florida. The east-coast fisheries are included in the fisheries of the South Atlantic States.

The office of Commissioner of Fish and Fisheries was created by Congress in 1871, but its independence as a separate branch of the government ceased in 1903, when it was made a bureau in the Department of Commerce and Labor. In a word, the purpose of the bureau is to increase the quantity and better the quality of the fish supply of the United States; and, to these ends, studies are made of different species; the coast waters, lakes, and rivers are stocked with young fish; and a general oversight is exercised of the whole fishing industry. It should be mentioned, however, that the fur-seal and salmon fisheries of Alaska are under the direct supervision of the Secretary of Commerce and Labor and not under the control of the Bureau of Fisheries.

CHAPTER XVII

MINERAL PRODUCTS

254. Introductory. This group of commodities presents a striking contrast in several important particulars to those of the animal and vegetable kingdoms. As has been pointed out (§§ 214, 234), many species of animals and plants have been carried from their native habitats and grown, often with wide variations from the original stock, under a new but somewhat different environment. A moment's reflection will show how entirely different it is with the minerals. These were laid down in certain definite places over the face of the globe once for all time. Consequently, there are no mineral emigrants such as we found among animals and plants. Man is well aware of this fact, but he gives little if any thought to the limitations thus imposed upon him by nature. He is so used to "triumphing over nature" through subtle brain activities that he is prone to forget that all his work in exploiting mineral resources must be confined to the areas of natural location (§§ 141, 161). Again, the supply of minerals is not inexhaustible, whereas the quantity of cereals, etc., to be produced yearly for all time to come is, within certain limits, subject to the control of man. For obvious reasons, therefore, it can be seen that those environmental factors of soil and climate which play so large a part in the life conditions of vegetable products do not have to be reckoned with in our discussion of minerals. Certain controlling conditions, such as nearness to centers of population and transportation facilities available, determine whether or not certain mineral deposits may be worked profitably.

Many of the great mining ventures owe their origin to the fact that mineral deposits are often exposed on the sides of hills or mountains or in river valleys. These exposures are usually on the windward side of ranges near the sea; thus copper was discovered on the west side of the Andes, in Chile, and coal on the western slopes of the Pennine range. Again, a sudden change of level in the interior may lay bare mineral wealth. Copper and nickel were found in this way in the Sudbury region in Ontario; also coal and iron between Moscow and Tula.¹

¹ See Lyde, *Commercial Geography of the British Empire*, p. 30.

According to the present known sources of the commercial minerals, their distribution among the continents as well as within them is strikingly uneven. Of course this varies according to the mineral under consideration. Iron occurs commonly as compared with antimony and tin; platinum and tin are extremely localized. In such undeveloped regions as large parts of Canada, Africa, South America, and Siberia numerous mineral deposits are likely to be found as these sections become better known. When the Canadian Pacific Railway was being constructed valuable mineral deposits were found, notably the nickel at Sudbury.

A convenient classification of minerals is that which divides them into two groups,—metallic and non-metallic. To the former belong iron, copper, gold, silver, lead, zinc, aluminum, quicksilver, antimony, platinum, tin, and nickel. In the United States there are more than fifty non-metallic minerals, of which coal and petroleum form the largest items in the value of output. The total value of the annual mineral production of the United States is approximately \$2,000,000,000. In 1905 it passed the \$1,500,000,000 mark for the first time in our history. The increase since 1902 has been close on to 50 per cent. The non-metallic minerals have the greatest value; but the figure for the total product, large as it seems, is only between one third and one fourth as great as that for our farm crops (cf. § 215). The yearly corn crop alone is worth more than the total annual value of all the non-metallic minerals.

METALLIC MINERALS

255. Iron. The value of our pig-iron output is over \$500,000,000 annually, or rather more than that of the wheat crop. Amongst all our minerals coal alone, including bituminous and anthracite, surpasses it in value. This country is taking such rapid strides in the production of iron that, in yearly output, it promises soon to lead the rest of the countries combined. The world's annual production of pig iron is about 60,000,000 tons. Of this the United States furnishes nearly 45 per cent, while the three leading producers—the United States, Germany, and the United Kingdom—contribute over 80 per cent of the whole.¹ As regards steel, the world's output is, approximately, 50,000,000 tons. The United States contributes nearly 50 per cent, while the three leading producers, the same as for pig iron, have a combined product of over 80 per cent of the whole. The

¹ See figures in the Appendix, Table X.

development of the iron industry in this country is well brought out by the accompanying chart (fig. 25) taken from "Mineral Resources of the United States," 1906, which shows, graphically, the production of iron ore, pig iron, and steel from 1870 to 1906.

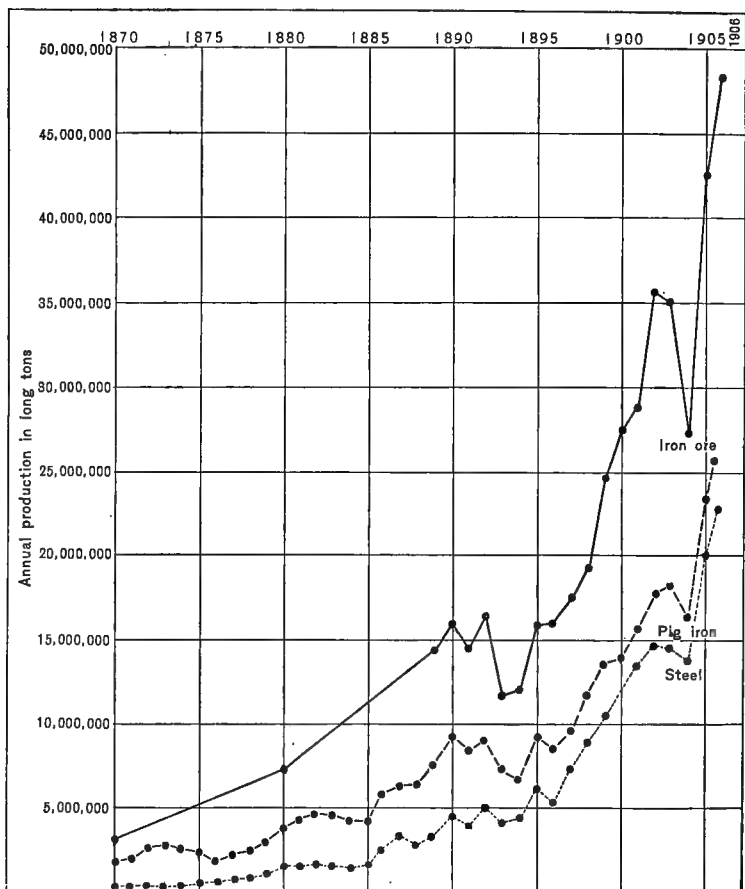


FIG. 25. Production of Iron Ore, Pig Iron, and Steel in the United States, 1870-1906

Iron ore is widely distributed in the United States, occurring in almost every one of the political divisions, although it is mined for blast-furnace use in less than thirty states and territories. These may be grouped conveniently into four districts:¹

¹ See Mineral Resources of the United States, 1906, p. 80. This volume of the United States Geological Survey and The Mining Industry during 1906, edited by W. R. Ingalls, have been drawn upon freely in preparing the chapter on Mineral Products.

1. The *Lake Superior* district, including Michigan, Minnesota, and Wisconsin.
2. The *Southern* district, including Alabama, Georgia, North Carolina, Tennessee, the Virginias, Maryland, Kentucky, Arkansas, Missouri, and Texas.
3. The *Northern* district, including western New England, New York, New Jersey, Pennsylvania, Ohio, and Iowa.
4. The *Western* district, including Colorado, Utah, Wyoming, Arizona, and New Mexico.

The relative output of each of these fields, in order, is 80, 13, 5, and 2 per cent of the whole. Thus it appears that the first field contributes four fifths and the second about one seventh of the total, while the output from the last two is comparatively insignificant. The Lake Superior field is at present the most important producer in the world.

Iron is extracted from the ores by smelting, and for this purpose some fuel, generally coal or coke, and limestone are required. Great changes have taken place in the method of smelting. Until 1840 the fuel in common use was charcoal; from 1840 to 1850 many experiments were being made with coal, both bituminous and anthracite; by 1850 the anthracite era in iron making started on this continent; ten years later bituminous coal and coke were becoming important factors in the smelting process, although it was not until 1875 that the production of pig iron by these fuels surpassed the output from anthracite.

Where coal and iron deposits occur near each other there is, other things being equal, a great opportunity to produce iron and steel at a minimum cost (cf. § 331). The Birmingham, Alabama, district is particularly favored in this respect, for there these materials as well as limestone are in juxtaposition. As yet, however, the southern iron fields have been little developed, owing largely to the scanty supply and poor quality of the labor. Moreover, it has been asserted that the profits of iron production in the South go chiefly to the railway companies in carrying pig iron to the northern market.

256. Copper. Copper is a widely distributed metal, occurring in greater or less quantities in most of the countries of the world. It is found in the pure state, but more frequently in the form of ores. It is very tenacious, ductile, and easily worked, and has been used in the arts from early times. Owing to its being an excellent conductor of heat and electricity, its consumption, during the last half century's wonderful material progress, has increased enormously. Efforts to

find a substitute for copper in electrical works have met with little success (cf. § 261). The electrification of suburban divisions of certain steam railways will add another demand. Two important alloys, bronze and brass, are formed, respectively, of copper and tin and copper and zinc (cf. § 260).

The world's annual output of raw copper was less than 9000 tons in 1801. To-day it is about 730,000 tons. In 1867 Chile's production was two thirds of the whole, and down to 1883 she stood first on the list. We have now taken this place, contributing about 57 per cent of the total yearly output. The countries next in order are Mexico, Spain, Japan, and Australasia. In the value of metallic mineral products our copper yield generally stands next to iron, the present figure being about \$180,000,000. The states or territories with the largest output are Montana, Arizona, and Michigan, producing 85 per cent of the whole. Nearly all of Montana's copper comes from the Butte district, which is the greatest copper camp in the world. The Michigan field is the one great native copper district; it follows without a break the axis of the Keweenaw peninsula for about 70 miles, with a width of from 3 to 6 miles. In Arizona, as contrasted with Montana and Michigan, the copper comes from many different sections of the territory.

257. Gold. Gold is a widely distributed metal, being found in all the continents and in most of the countries of each. It occurs commonly in volcanic districts, but is not associated with any particular geological period; it is found pure or native, imbedded in rocks in quartz veins, in nuggets, or in placer deposits. The use of gold as a standard of value and as a medium of exchange is due, in large part, to its high value as compared with its bulk. For this reason and from the facts that it does not tarnish and is pleasing to the eye, and that it is the fashion to wear articles made in whole or in part from gold, it is employed extensively in the arts. To lessen the abrasion it is alloyed with silver and copper, which process increases its hardness.

A graphic representation of the development of the world's gold production since the discovery of America is shown by the accompanying diagram (fig. 26) taken from Bartholomew's "Atlas of the World's Commerce," Part 6.

Observe the comparatively small output until the mines of California and Australia were discovered in the middle of the nineteenth century. The increase during the last decade has been great. Improved methods of extraction, the discovery of new deposits, the development, especially since the Anglo-Boer War, of South African

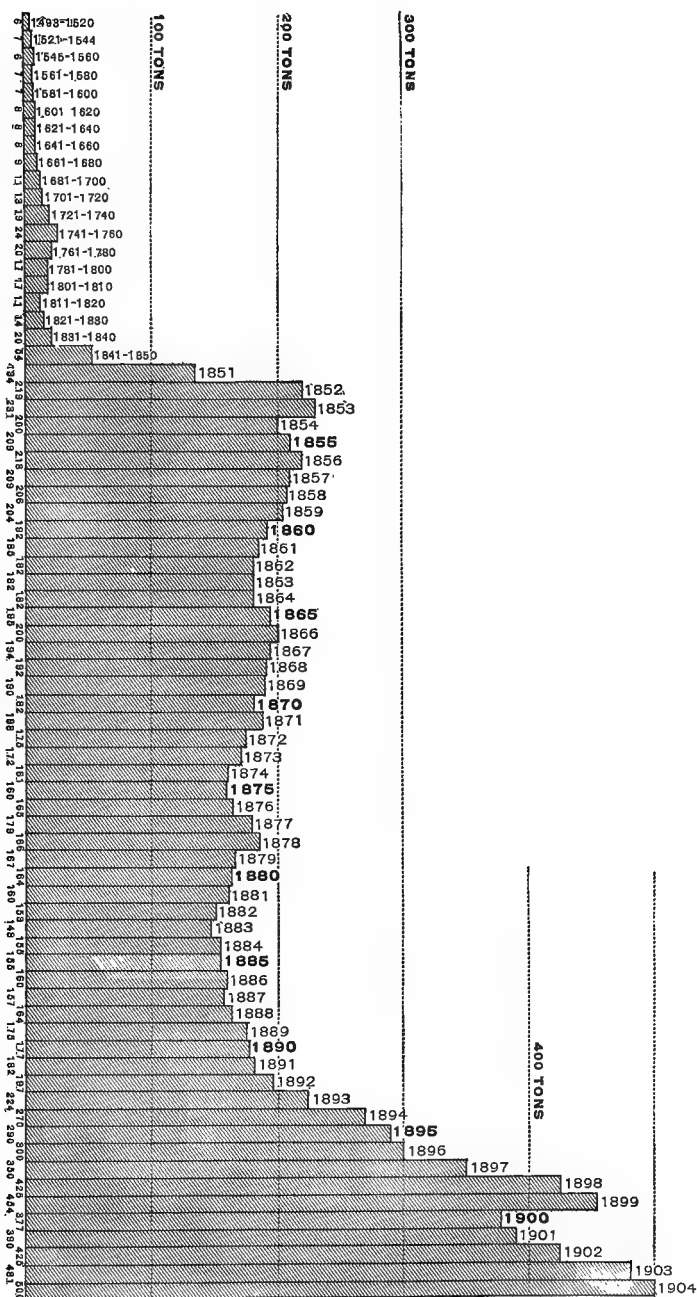


FIG. 26. Development of the World's Gold Production since 1493

fields, and the constant demand for the precious metal account, in part at least, for the phenomenon.

For a long time the United States held first place in gold production, but in 1898 South Africa took the lead. Owing to the war in the Transvaal, Africa's gold production dropped to \$8,600,000 in 1900. At the conclusion of the war it began to increase, and in 1905 Africa again outstripped all other gold-producing countries. The world's output, at present, is somewhat less than 20,000,000 fine ounces, valued at \$400,000,000. This is considerably less, however, than the farm value of our average wheat crop (cf. § 215). The United States holds second place; Australia, third. These three countries contribute about three fourths of the whole output. Those next in order are Russia, Mexico, and Canada.¹

258. Lead. Lead is a heavy, soft metal seldom found in a pure state, but commonly as galena (sulphide of lead), or as a carbonate called cerussite. The former bears more or less silver, and lead is often turned out as a by-product in silver production. It has become more and more necessary with the advance of material development, for it is used for pipes, cisterns, roofing, and shot. Also many alloys such as type metal, solder, and pewter contain lead, and it forms a part of numerous chemical compounds used extensively in the arts. The world's output is considerably less than 1,000,000 tons annually.² The United States leads the world with about one third of the total. Seventeen states, including Alaska, produce lead, although in all but four of them the output is small. Idaho takes first place, contributing nearly 34 per cent, and Missouri nearly an equal amount, while Utah and Colorado yield about one half the amount of the other two states.

259. Silver. Silver is found native at times, but more commonly it occurs in ores combined with other metals such as copper, lead, and zinc.

The commercial value of our product is over \$38,000,000 annually. Twenty-two states and territories, including Alaska, contribute to the output, chief among which are Colorado, Montana, Utah, and Idaho. The commercial value of the world's output is over \$110,000,000. Sixty per cent or more comes from the North American continent. Our production in 1906 exceeded that of Mexico for the first time in several years. There has been an enormous development in silver mining during the last half century. Till 1860 the total yearly

¹ For figures of gold production by countries and by states in the United States, see the Appendix, Tables XI and XII.

² See figures in the Appendix, Table XIII.

output had never reached 900 tons, but about that time (1859) the great Comstock lode in Nevada was discovered and at once the United States came to the front as a silver producer. To-day the world's output is over 5000 tons annually.

A large percentage of the supply of silver is minted. On account of its softness it is alloyed with copper when coined; in this country the proportion is 9 parts of silver to 1 of copper. Its other more common uses are for the manufacture of silverware and jewelry and in photography.

260. Zinc. Zinc is a hard metal occurring with others such as lead and copper; the crude metallic commodity is called spelter. Its uses are varied; when alloyed with copper it forms brass, and with copper and tin, a variety of bronze. A common use is in coating thin sheets of iron (galvanizing) to protect the latter from oxidation. Zinc white, a powder used in paints, is obtained by subjecting the zinc to intense heat until an oxide is formed.

The world's annual production of spelter is, roughly, about 775,000 short tons; the figure varies considerably from year to year. A great demand naturally results in a rapid increase in price, which, in turn, encourages production. Germany and the United States each have an output of about 250,000 tons, while Belgium, the only other large producer, adds considerably less. These three countries contribute about six sevenths of the whole output.

The value of our annual yield is about \$25,000,000. Over a dozen states mine zinc-bearing ores, but Missouri alone is the source of two thirds of the spelter derived from domestic ores. Excepting a small quantity from the southeastern part of the state, the whole supply comes from the region known as the Missouri-Kansas, the Joplin, or the southwestern Missouri district. It runs over into southeastern Kansas, also into northeastern Oklahoma.

261. Aluminum. Aluminum is widely distributed and, in combination with other elements, forms about one thirteenth of the earth's crust. Comparatively speaking, it is one of the new metals, for it did not come into prominence until twenty-five years ago. This was because of the expensive processes used in extracting it from its compounds; cheaper methods have been discovered, however, and now, by the electrical process, the cost of producing the metal has been reduced so that it is coming into common use. It has a whitish color, is light, being about one quarter as heavy as an equal bulk of silver, and does not oxidize easily. It competes somewhat with copper in the electrical industry (cf. § 256). Besides the more familiar

uses, it is coming to be employed extensively for musical-instrument construction, camera cases, dress-suit-case frames, mailing tubes, artificial limbs, refrigerator linings, racks, and railway-car linings.

Few nations, as yet, produce aluminum. It is predicted¹ that countries with abundant and cheap water power, like India and Japan, will soon be important producers, and that within the next few years the world's output will be several times what it is at present. The world's production is, approximately, 40,000,000 pounds. Our yield is about three eighths of the whole; Switzerland, France, and Great Britain contribute the rest. The growth of the aluminum industry in the United States has been connected with a single plant,—the Pittsburg Reduction Company,—which on January 1, 1907, changed its name to the Aluminum Company of America. In 1906 it was the only producer of the commodity in the United States.

262. Quicksilver. Quicksilver or mercury is a fluid metal. It occurs native but more commonly as a sulphide of mercury, or cinnabar. The method of reducing the ore consists in volatilization (freeing the mercury from the associated elements) and condensation (reducing the vapor to liquid form and collecting it). The commercial product is shipped in iron flasks containing about 75 pounds avoirdupois net. Hitherto its principal use has been in recovering the precious metals by amalgamation, but recently the increasing adoption of other processes, especially in the United States, has decreased the demand. Mercury has many other uses; combined with tin it forms an amalgam for silvering mirrors; it is used also in dentistry, medicine, and in making scientific instruments.

The United States, Spain, Austria, Italy, and Russia, in the order here given, are the important and almost the sole producers. China has deposits of cinnabar that have been worked since the fourteenth century; the output at present is small and it is used at home for the manufacture of vermilion. The value of the world's annual yield of quicksilver is between \$3,000,000 and \$4,000,000, and our contribution is about one third of this figure. The greatest single mine is at Almadén, Spain, which has been worked from Roman times; for a long time Spain led in production, but in 1850 the famous mines at New Almaden, California, were opened and since then our yield has been important. The output of the California mines is now about seven ninths of the whole yield of the United States. The other producing states are Texas, Utah, and Oregon. Recently a cinnabar deposit has been located in Arizona.

¹ See *The Mineral Industry during 1906*, p. 18.

NON-METALLIC MINERALS¹

263. Coal. The present-day industrial organization is so dependent upon an adequate supply of coal that its abundance or scarcity in any particular country is a fairly safe index of the place that country is capable of taking in the struggle for industrial supremacy. It is a significant fact that the three great rivals in this struggle—the United States, Great Britain, and Germany—are by far the greatest producers of coal. A moment's reflection will show how greatly handicapped any one of these countries would be if all of its coal had to be imported. Its great bulk as compared with its value sets a limit to the distance it may be carried. With the development of modern transportation systems this limit is being increased, and a country poorly supplied with coal is at a less disadvantage than it was fifty years ago. Coal is, more than ever, "the material energy of a country, the universal aid, the factor in everything we do."

As regards the origin of the coal deposits, the following extract from "The Mining Industry during 1906" (p. 168) is of interest:

"A great many theories have been evolved dealing with the methods and forces that have operated in forming our coal deposits. Of the many ideas recently presented, the one most favorably commented upon ignores the conclusion that our coal beds are the remains of great primeval forests. More careful thought and examination lead us to believe that all of our coal seams have been formed from minute vegetable matter that probably lived and flourished at the bottom of inland lakes, being deposited year after year for a long period, with layers of sand and other material, while later ages furnished the pressure and heat necessary to complete the transformation. The principal argument in favor of this theory is that the parting between coal seams and the underlying and overlapping strata are perfectly uniform and even. The strata forming the floor for beds of coal do not show any traces of the roots or stumps of large trees, nor indeed any evidences of large vegetable growth."

Two classes of coal figure most extensively in commerce. They are bituminous and anthracite. The former contains from 85 to 88 per cent of carbon, along with gas, tar, etc. It lights easily and burns with a bright flame, and is the great fuel for producing steam and for the manufacture of coke. Anthracite contains more carbon, sometimes as much as 95 per cent, and less gaseous and tar products. It burns with little flame but produces great heat, and is used extensively for domestic purposes, especially in the eastern part of the United States. Another variety of much less use in industry than

¹ No attempt will be made to discuss here all of the long list of non-metallic minerals found in this country. Only the more important, from the standpoint of the money value of their annual output or of their use in the arts, will be considered.

either of the above is lignite or brown coal. It contains relatively a small amount of carbon, approximately 70 per cent. Coke is an artificial product made by heating certain grades of bituminous coal in ovens with a limited supply of air, the volatile matter passing off, and the residue, which is hard carbon, resembling anthracite, is the coke. At the present time it is the great fuel used in smelting iron in this country, for 90 per cent or more of our pig iron is thus produced.

Coal is a widely distributed mineral, yet, as already indicated, its production is controlled largely by the United States, the United Kingdom, and Germany. From 1870 to 1900 the output of these three countries was five sixths of the world's total yield, although they contained but one tenth of the world's population. Their relative outputs have changed considerably during the last forty years. In 1868 the United Kingdom produced over three times as much as either the United States or Germany, their respective outputs being 52, 14.5 and 16.5 per cent of the whole. Between 1875 and 1880 there commenced a substantial increase in our yield, due in part at least to the demand of our factories, railways, blast furnaces, and gas works. The United Kingdom held first place as a producer of coal until 1899, when she was forced into the second rank by the United States. The world's annual production of coal is about 1,100,000,000 short tons.¹ The United States produces between 35 and 40 per cent of the yearly output, and, excluding the United Kingdom, our production exceeds that of all the other countries of the world combined. Moreover, it is the most valuable mineral product of the country, exceeding \$500,000,000 annually. The pig-iron product nearly equals it in value (cf. § 255).

There are eight principal coal fields in the United States. The anthracite area consists of about 484 square miles in the state of Pennsylvania (cf. § 63). In addition to this well-known district there are two minor ones in the Rocky Mountains, one in Gunnison County, Colorado, the other in Santa Fé County, New Mexico. The bituminous fields are scattered over a wide area, including about 335,000 square miles. They are the Triassic field in Virginia and North Carolina; the Appalachian, extending 900 miles from New York to Alabama, with a width varying from 30 to 180 miles; the Northern, in central Michigan; the Eastern, in Indiana, Illinois, and western Kentucky; the Western, including the coal areas west of the Mississippi, south of 43° north latitude, and east of the Rocky Mountains; the Rocky Mountain field, in the states and territories of

¹ The output by countries is shown in the Appendix, Table XIV.

those mountains ; and the Pacific coast field, in the states of Washington, Oregon, and California. The percentage outputs of these districts in 1906, which was a representative year, were as follows :

Appalachian	68.10
Eastern	17.34
Western	6.73
Rocky Mountains	6.44
Pacific Coast	.99
Northern	.39
Triassic ¹	

Pennsylvania leads with nearly 50 per cent of the total production. The other states in order of output are West Virginia, Illinois, Ohio, Alabama, and Indiana.

Various attempts have been made from time to time to estimate the world's coal supply. Such estimates are of little value on account of the lack of adequate information. However, they demonstrate the fact that there is little danger of exhausting the fields in the near future. Germany, for instance, is said to have a reserve of 280,000,000,000 tons, which, allowing for a substantial increase of output beyond the present, would last till the year 3000.

264. Petroleum. Petroleum, or rock oil, is a natural inflammable liquid obtained, usually, by boring into the earth, whence it gushes or is pumped out. It occurs in chambers or reservoirs amidst strata of rocks, and often is associated with water and natural gas. In such cases there are three layers, the water being at the lowest level, the gas at the highest, and the oil between. Numerous commercial products are obtained from the crude petroleum by distillation and other processes, among which are kerosene, benzene, gasoline, naphtha, heavy or lubricating oils, and paraffin or asphalt, according as the crude oil has a paraffin or an asphaltic base. The illuminating mineral oils, in competition with vegetable and animal oils, are rapidly driving the latter out of the market (cf. § 245). The same is true of mineral lubricants. The latter are less liable to spontaneous combustion and are more lasting than other oils. There are many grades of crude petroleum ; hence the qualities of the refined oils are innumerable. A great number of by-products, such as vaseline and candles, are associated with the manufacture of petroleum.

Until comparatively recent times the production of petroleum was insignificant, although crude oil is found in many parts of the world,

¹ No figure reported for 1906, although for several years before there had been a small output.

and has been known at least from the time of the Greeks and Romans. On account of the peculiar nature of the product it required the development of modern transportation systems, including pipe lines, before it could serve any but local markets. Consequently, not until within the last half century, when the fields of Russia and the United States began to be worked, did the oil business come into prominence.

The world's annual production of crude petroleum is, roughly speaking, more than 200,000,000 barrels of 42 gallons each. The United States and Russia contribute about 90 per cent of the whole, and the United States alone 60 per cent. Since 1902 the United States has taken a big lead over Russia in oil production; the Russian yield in 1905 and 1906 was below the normal, owing to a disastrous fire in August of the former year, which destroyed a large number of drilling cranes. For this and other reasons it probably will be some time before the normal output is reached. The balance of the world's petroleum comes from various countries, of which Galicia, Roumania, India, Japan, Sumatra, Java, and Borneo are the most important.

The first oil well in this country was driven near Titusville, Pennsylvania, in 1858, and the following year 2000 barrels were produced; for seventeen years Pennsylvania was the only state producing oil. Later the industry grew to large proportions, and by the opening of the present century the annual output was over 63,000,000 barrels. By 1906 this figure was doubled. Thousands of miles of pipe lines lead out from the wells to the refineries, thus effecting a great saving in the cost of transportation.

The oil fields of the United States as given by the Geological Survey¹ are as follows:

Appalachian field, producing oil of paraffin base of the best quality. It extends along the western side of the Appalachian Mountains from New York, through Pennsylvania, southeastern Ohio, West Virginia, and Kentucky into Tennessee.

Lima-Indiana-Illinois field, containing oil of paraffin base. This field includes the northeastern part of Ohio, a strip through the middle of Indiana, and the southeastern portion of Illinois.

Mid-continent field, producing oil with a mixed asphalt and paraffin base of varying qualities. It includes western Missouri, Kansas, and Oklahoma.

Gulf field, producing oil chiefly with an asphalt base. It is obtained from the coastal plains of Texas and Louisiana and from central Texas.

¹ Mineral Resources of the United States, 1906, pp. 832-833.

California field, the oil being of an asphalt base. At present it is obtained from southern California and from the south end of the San Joaquin Valley. Wyoming, Colorado, and Michigan also produce small quantities.

On reference to the table¹ in the Appendix, it appears that the production of the Appalachian field has, within a short period, fallen from about one half to less than a quarter of the total output. The change has been brought about largely by the increased output of other fields rather than by any serious absolute decline in production. Other striking changes can be observed from the table.

The petroleum industry is growing rapidly in Canada, Mexico, Japan, and other countries where the discoveries of the mineral give every assurance of an abundant world's supply for a long time to come.

265. Natural gas. As already mentioned, natural gas generally is found associated with petroleum; formerly, when the latter was being sought, the gas was considered a nuisance. It is said to have been first used in 1821, when the town of Fredonia, New York, utilized it for illuminating and heating, but not until half a century later was it commonly employed for these purposes. One of the first instances of its being used in industry was in 1874, when it was brought 18 miles in pipes to an iron mill near Pittsburg and used in heating and puddling furnaces. At the present day the value of our yearly output of natural gas is nearly \$50,000,000. It is generally consumed in the state where it is produced, for illuminating purposes or for supplying heat in neighboring furnaces. Pennsylvania and West Virginia are the largest producers, contributing respectively about one third and one quarter of the whole supply, while Ohio, Kansas, and Indiana follow next in order.

266. Clay products. Clay products form a large item in the total value of our non-metallic mineral output. In an average year their value is upwards of \$160,000,000, so that in money value they stand second only to coal. They may be divided roughly into two classes, brick and tile, and pottery. The former comprise about 80 per cent of the total value of the output. The clay-working industries are an important factor in the material development of the country, since brick and tile products enter extensively into so many kinds of structural work. The cities, of course, are the largest consumers, and when building operations decline the clay industry is seriously affected. The clay resources of the United States are illimitable, and practically

¹ Table XV.

every known variety is found. The value of the raw commodity is dependent upon its nearness to points of consumption, since only the highest grades will stand the cost of transportation. Every state and territory in the Union figures to a greater or less extent in the production of clay goods. Ohio leads, while Pennsylvania, New Jersey, New York, and Illinois come next in order.

267. Stone. An important source of this country's material wealth is found in the abundance and great variety of stone available for building and other purposes. The value of the annual output at the quarries is over \$65,000,000, or about one half that of the anthracite coal production. Limestone, granite (cf. § 38) and trap rock, marble, sandstone, and bluestone are the principal stones quarried. Limestone constitutes about 40 per cent of the total value of the output. The states in order of greatest production are Pennsylvania, Indiana, Illinois, New York, and Missouri. The chief use of limestone is (in crushed form) for road making, railroad ballast, and concrete, although its utilization for furnace flux, building stone, and in the chemical arts is important. One third of the value of the stone production consists of granite and trap rock. Massachusetts, Vermont, Maine, California, Connecticut, and Pennsylvania in order are the chief producers. Granite has a variety of important uses, notably for building stone, monuments, paving blocks, and curbstones. The marble yield is about 11 per cent of the whole, and its greatest use is for building and for monumental work. Vermont easily leads in output, followed by Georgia, Tennessee, and New York. The production of sandstone and bluestone is comparatively small, and the output seems to be dropping off somewhat, owing to the fact that cement and concrete blocks are becoming serious competitors. Pennsylvania, New York, and Ohio are the principal producers.

268. Other non-metallic minerals. Other non-metallic mineral products in order of value are cement, lime, phosphate rock, mineral waters, salt, zinc white, and slate. Valuable data regarding them can be obtained from the various volumes of "Mineral Resources of the United States," published by the United States Geological Survey, or from "The Mineral Industry during 1906," edited by W. R. Ingalls.

CHAPTER XVIII

MANUFACTURES

269. Introductory. Hitherto our discussion has been concerned mainly with the natural resources of this country, but a large proportion of these are not utilized by man in the raw state and consequently they must go through various processes before they emerge in a form which will satisfy his various tastes. Hence our discussion at this point naturally leads over to manufactures. Lack of space prevents a discussion of the circumstances connected with their development from colonial times. The table¹ in the Appendix shows, however, their rapid expansion since 1850.

The influence of environmental factors upon the location of industries is difficult to trace, and especially is this true under present-day conditions. But it is possible to point out in a general way that there were certain controlling factors in the establishment of some of the manufacturing plants. For example, the excellent water power along the "fall line" in New England, and the absence of extensive stretches of agricultural land that could easily be tilled, contributed largely to the early establishment of mills and factories in that section of the country (cf. § 63). It is probably true that a number of the industries still located there could now be carried on successfully elsewhere; but the fact that this region got a start over others has tended to keep down competition, to a greater or less extent, from other quarters. Again, it was almost inevitable that the iron and steel industries should develop primarily near the coal mines of southwestern Pennsylvania and along the shores of lakes Michigan and Erie rather than in the vicinity of the iron mines of Lake Superior (§ 63); for it is cheaper to send the iron ore to the coal than vice versa. Other instances of the geographic or other factors in the environment as influencing the location of industries will be pointed out in succeeding pages, while numerous others will doubtless occur to the reader.

270. The factory system. The factory system which already had a foothold in England at the close of the eighteenth century did not

¹ Table XVI.

become generally established in the United States until the second quarter of the nineteenth century. Agriculture was the predominating occupation, and many of the domestic articles necessary to the greater mass of the people were made in their own homes, while the wealthier classes drew upon other countries, when necessary, to supply their wants; hence the comparatively small value of our manufactures in 1850. The greatest development has taken place since 1880, and numerous causes have contributed to this expansion, notably the increased supply of raw materials, improved transportation facilities, increase of population, higher purchasing power of the masses, and the foreign demand for certain manufactures. To-day we lead the world as a manufacturing nation, but the enormous demands of the home market are such that only about one twentieth of the total product is exported. The industries are also greatly diversified and are widely scattered throughout the country, yet the densely populated region of the northeast is the most truly manufacturing district. New York, Pennsylvania, Illinois, and Massachusetts, in order, are the leading states, having together 40 per cent of the establishments, 45 per cent of the wage earners, and contributing 47 per cent of the value of the output of the entire country. Again, the factories in the territory east of the Mississippi River and north of the Ohio River and Mason and Dixon's Line employ three fourths of all the wage earners and turn out nearly the same fraction of the value of the total product. As regards the latter feature, slaughtering and meat packing are the most important industries, although the manufacture of lumber and timber gives employment to the largest number of wage earners.

271. Groups of American manufactures. The Census Bureau has divided the 339 different classes of manufactures that are being carried on in the United States into 14 groups. These with the number of establishments, the capital, the wages paid, and the gross value of the products of each are shown in the Appendix.¹

272. Food and kindred products. This group surpasses all others in the value of its products. The greater quantity of the raw materials used in the manufacture of foods is obtained from agriculture, and, as a rule, the articles produced by the establishments are ready for final consumption. Important items falling within this group are slaughtering and meat-packing products; flour and grist-mill products; butter, cheese, and condensed milk; canned and preserved fruits, vegetables, and fish, and refined sugar.

¹ Table XVII.

The development of the slaughtering and meat-packing industry has been rapid. Fifty years ago the capital invested was less than \$3,500,000, while to-day it is nearly \$200,000,000. The center of the industry which in 1850 was in the Ohio Valley has moved farther west, and there has been a marked tendency towards concentration in large centers in the central and western states near the great stock-raising sections (§ 239) and where good transportation facilities are found. That is to say, the business is becoming adjusted to its best environment where economies may be practiced in saving transportation charges in the initial stages of manufacture ; it is much cheaper to send canned meat a considerable distance to market than to assemble the cattle for slaughtering at points near the consumers but which may be thousands of miles from the stock-raising centers. Chicago leads in this industry, contributing 30 per cent of the value of all the products. Kansas City, Kansas, and South Omaha, Nebraska, are second and third respectively.

Our enormous cereal crops (cf. §§ 216, 217, 218, 219) give rise to an extensive flour- and grist-milling industry ; and the development of grain production has been followed by a corresponding increase in its manufacture. In 1850 the value of the products of the flour and grist mills was \$136,000,000 ; at the present time it is over \$700,000,000. The center of the industry is in the North Central States, where over 50 per cent of the capital is invested and nearly 60 per cent of the value of the products appears. Minneapolis, on account of its favorable position with reference to the wheat belt, and with an abundance of water power furnished by the Falls of St. Anthony (cf. § 93), has become the chief milling center of the United States and of the world. In 1904 the value of the output of the mills in Minneapolis was five and one-half times that of the next largest milling center, New York City. Buffalo, Milwaukee, and Kansas City, in the order named, follow these two leaders. Wheat flour forms two thirds of the total value of the products, while the by-products in its manufacture are over 10 per cent. Other important items are corn meal, rye and buckwheat flour, and feed.

Butter, cheese, and condensed milk to the value of \$170,000,000 annually are now factory products. Fifty years ago practically all of the dairy products were manufactured on the farms ; but, as a natural development in the evolution of industry, creameries, cheese factories, and condenseries came to be established, and the making of dairy products was separated from farming. In 1850 there were only 8 cheese factories in the United States ; in 1905 there were nearly

9000. Over two thirds of all dairy products are made in six states,—New York, Wisconsin, Iowa, Illinois, Minnesota, and Pennsylvania. Near the large cities there is a tendency for farmers to sell their milk and cream directly to the consumers, but where the local demand is small these commodities go to the manufacturing plants.

On account of the perishable nature of many food products, much time and effort has been spent in perfecting methods whereby they may be preserved for use out of season and in localities where they are not produced. The process of canning in hermetically sealed jars was developed successfully in France at the beginning of the nineteenth century. Attempts were made to introduce the industry into the United States about 1825, but not until after the middle of the century did it become of any importance. Maryland soon became the center of the canning business, but Maine, New York, and New Jersey were prominent. The industry was confined to fruits and vegetables for a considerable time, but later it was extended to meats, fish, and oysters. The total value of the canned goods, exclusive of meats, is over \$100,000,000, and fruits and vegetables constitute over 70 per cent of the whole. The five leading states are California, Maryland, New York, Indiana, and Illinois. The climatic conditions in the first-named state have made it famous for its fruits; hence it leads in preserving, and peaches are the largest item. Maryland easily leads in the canning of tomatoes, and New York in peas.

In order that all possible economies may be taken advantage of, sugar refining is done in immense plants. The difference between the price of the raw and refined product is only about one cent per pound. Largely to save the cost of transporting the raw commodity which is imported in enormous quantities, the refineries are situated near the coast, notably in such cities as Brooklyn, Jersey City, Philadelphia, New Orleans, and San Francisco.

273. Iron and steel and their secondary products. This group, which ranks second in value of products and first in capital represented and annual wages paid, comprises 37 different industries, of which the manufacture of iron and steel is the basis. Upon this is founded all the other industries of this group, such as those which produce structural iron and steel, rails, machinery, tools, hardware, tin plate, cutlery, wire, and numerous other more highly refined commodities such as watch springs, pens, and needles. The principal seat of the iron and steel industry is in western Pennsylvania (§§ 63, 269) although it is found in 27 states. Between 80 and 90 per cent of the total output comes from Pennsylvania, Ohio, Illinois, and Alabama,

the first-mentioned state producing over one half of the country's output in an average year. Pennsylvania leads also in the production of structural steel, with six tenths of the total product ; next in order are New Jersey, Illinois, and Ohio. Nearly 2,250,000 tons of rails are manufactured annually ; a dozen or more establishments are engaged in the process, and Pennsylvania turns out about three eighths of the whole product. Illinois, New York, and Maryland are the next largest producers.

274. Textiles in general. The raw materials which form the basis of the textile manufactures are vegetable and animal fibers (§§ 223-228, 241, 323, 376, 406-411). It was in this branch of industry that the factory system arose in the United States. This group ranks high among our manufactures not only on account of the enormous output of the factories, but also because it furnishes the material for practically all of the clothing of the masses excepting leather goods and hats. Besides, it furnishes many articles of household use, such as carpets, draperies, and towels. More wage earners derive a livelihood from it than from any other group. Our textile manufactures comprise 44 industries, but the most important are those which relate to cotton, wool, and silk. Brief discussions of some of the leading items follow.

275. Cotton manufactures. The cotton mills of the United States consume more than one quarter of all the raw cotton grown in the world, standing, in this respect, second only to those of the United Kingdom (cf. § 338). Cotton factories were in operation in this country before the beginning of the nineteenth century, but it was not until foreign importations were cut off by the War of 1812 that cotton manufacturing was firmly established. Since that time the business has expanded rapidly, each successive decade showing an increase in the number of operatives and in the quantity and value of the product. By 1850 the output of the cotton mills was valued at \$62,000,000, while now it is nearly \$450,000,000. The chief seat of the industry always has been in New England, where the moist climate (cf. § 337) and cheap water power along the "fall line" furnish a favorable environment (cf. § 269). Within recent years important cotton manufactures have developed in the South, the number of establishments increasing from 161 in 1880 to 550 in 1904. Of the 23,116,000 or more spindles in operation in the whole country, 14,000,000 are in the New England and 7,500,000 in the Southern States. Massachusetts still remains, as it always has been, the leading state in this industry, having more spindles than the next

four producers combined. Recently South Carolina has taken second place from Rhode Island, and North Carolina, Georgia, and New Hampshire hold, respectively, the fourth, fifth, and sixth places. Spinning and weaving are carried on usually in the same factory. Where this is not the case the establishments are generally small. The largest output of American cotton mills consists of various classes of coarse- or medium-grade goods such as calico, gingham, and shirting, for which there is a big demand in the home market. There is a tendency to produce finer goods, especially on the part of the mills in the South.

276. Woolen manufactures. Here are included five different classes of manufactures, varying greatly, however, in their relative importance. The three of large value are worsted goods, "woolen" goods, and carpets. Those of less value are felt goods and wool hats. Hosiery and knit goods will be discussed under a separate heading. The total value of the products has increased from less than \$75,000,000 in 1860 to nearly \$400,000,000 at the present time. About 500,000,000 pounds of wool are consumed by our mills annually, a good deal of which is imported (§ 241). All important manufacturing countries produce less wool than they require in their textile industries, so that regions with large grazing areas, such as Argentina, South Africa, Australia, and New Zealand, are drawn upon to meet the demand.

Many mills weave both woolen and worsted yarns, so that it is difficult to classify them according to the nature of the product. Merinos, serges, cashmeres, linings, and other stuff goods are important worsted manufactures. Cloth for men's and women's suits, blankets, and carriage robes are leading items among "woolen" goods. The worsted industry was scarcely known in this country in 1860, but now it exceeds the "woolen" manufactures in the value of product. Moreover, it consumes the largest amount of wool as well as that of the best quality.

In the manufacture of carpets we surpass all other nations both in quantity and variety. The American producers have almost a complete monopoly of the home market. Only a small percentage of the total amount expended yearly in this country for carpets goes for imported stock. The latter is largely of Oriental production.

As already mentioned, the manufactures of felt goods and wool hats are comparatively insignificant. The former consist chiefly of felt cloth, endless belts, and boot-and-shoe linings. The production of wool hats is declining.

Massachusetts ranks first in the production of both worsted and woolen goods and third in that of carpets. Rhode Island, Pennsylvania, and New Jersey are, in order, the other largest manufacturers of worsteds; while Pennsylvania, Maine, Connecticut, and New Hampshire rank high in the production of woolen goods. Pennsylvania is the first state in the output of carpets, New York holding second place.

277. Hosiery and knit goods. The knitting machine was invented in England as early as the latter part of the sixteenth century, but not until very recent times has the machinery been perfected so that goods of fine quality could be made at a cost sufficiently low to be within the reach of the masses. As late as 1880 the knit goods manufactured in the United States were of the cheapest and coarsest kind, and 74 cents per capita was the average annual expenditure for them. All of the finer sorts were imported to the extent of one fifth of the total consumption. The per capita expenditure now is about \$1.80, and foreign importations are on the decrease. Since there has been also a great reduction in price, it is fair to say that the American people consume three or four times as many machine-made knit goods as they did 25 years ago. Hosiery and knit underwear, including silk goods, account for nearly 80 per cent of the total value (\$136,558,000) of the product. Cohoes, New York, is the great center of underwear manufacture, and Philadelphia of hosiery.

278. Silk manufactures. In this important branch of our textile industry we are dependent entirely upon foreign countries for the raw material. The climatic conditions in the United States are favorable for the growth of mulberry trees and for the rearing of silkworms; but much hand labor is necessary in preparing the skeins of raw silk from the cocoons, and the comparatively high cost of labor in this country prevents us from competing in raw-silk production with the countries of southern Europe and the Orient. The manufacture of sewing silk as a household occupation in New England was the commencement of our silk industry. Ribbons were made at Baltimore as early as 1829. Until the time of the Civil War these commodities, and fringes, gimps, and tassels were the principal items in the output. Since 1860 the growth of the industry has been rapid, and various classes of goods such as silk yarn, twist and sewing silk, dress goods, velvets, plushes, tapestries, ribbons, and laces are made in great quantities to the value of nearly \$140,000,000 annually. This makes the United States one of the leading silk-manufacturing countries in the world. Pennsylvania recently has surpassed

New Jersey as the leading state in silk manufacturing, though Paterson, New Jersey, is still the "Lyons of America." The industry is confined largely to four states, — the two already mentioned, Connecticut, and New York, — for 90 per cent of the total capital invested in silk-manufacturing plants is found in these states.

279. Flax, hemp, and jute products. Here are included not only the manufactures of flax, hemp, and jute, but those of other vegetable fibers not yet discussed such as sisal and Manila (§§ 323, 409). The products are greatly diversified, varying from gunny bags and ships' hawsers to delicate toweling and sewing thread. Besides these, other important items are cordage, binder twine, burlaps, carpets, and rugs. The annual value of such manufactures is about \$63,000,000. The most important branch of the industry is the production of cordage and twine, in which three fourths of the number of establishments and three fifths of the number of employees are engaged.

280. Lumber and its manufactures. There are three distinct but interdependent branches of the lumbering industry, namely, logging, sawing, and re-manufacturing certain sawn products. Most of the important facts in connection with our lumbering industry were given under the head of Forest Resources (§§ 229, 230, 231). The annual value of the raw forest products is greatly increased by the re-manufacture of a considerable quantity of rough lumber into ceiling, flooring, sashes, doors, blinds, interior finishings, and furniture. The latter (furniture) to the value of \$150,000,000 per year is manufactured in the United States. Important centers of the industry are New York, Chicago, Philadelphia, and Grand Rapids.

281. Chemicals and allied products. Within this group are included a great variety of manufactures such as sulphuric and other acids, sodas, potashes, alums, coal-tar products, cyanides, fertilizers, bleaching materials, chemicals produced by the aid of electricity, dyestuffs, tanning materials, paints and varnishes, explosives, plastics, essential oils, compressed and liquefied gases, and a large number of miscellaneous chemicals. The production of these commodities is widely distributed, but over 50 per cent of all the establishments and about 60 per cent of the products belong to Pennsylvania, New York, New Jersey, Ohio, and Illinois.

282. Metals and metal products other than iron and steel. Thirty-four classes of industries are included in this group. In general, they relate to the smelting and refining of copper, lead, and zinc; to the reduction of gold and silver; and to the making up of these metals into such finished products as watches, clocks, jewelry, needles, and

pins. Large quantities of copper are consumed in making electrical apparatus, but so many other materials figure in its manufacture that it is considered under the heading Miscellaneous industries (§ 290). About 50 per cent of the value of the annual product of this whole group consists of the smelted and refined copper, lead, and zinc.

283. Paper and printing. Here are included the manufacture of wood pulp and all kinds of paper, together with such allied industries as printing, publishing, bookbinding, blank-book making, and paper-box manufacturing. Of the 21 industries included in this group printing and publishing are by far the most important. They include 85 per cent of the establishments and 58 per cent of the value of the products. The increase in the business of printing and publishing since 1850 has been rapid, the per capita value of the output now being tenfold greater than in 1850. Six states (New York, Illinois, Pennsylvania, Massachusetts, Ohio, and Missouri) contribute two thirds of the value of the products of the entire industry.

284. Leather and its finished products. The primary industry in this group is tanning, and the plants engaged in this work furnish the raw material for eight or more other industries included here. The manufacture of boots and shoes is the leading item, although large quantities of leather are used yearly for making gloves, harnesses and saddles, pocketbooks, trunks, and valises. The figures of the last census show that Massachusetts ranked first in every particular concerning shoe manufacturing, and that, in the same way, the New England States are far in the lead of any other group of states, employing more than one half the total capital and making more than one half the total output of boots and shoes. The western states, however, are forging ahead rapidly in this branch of manufactures.

285. Vehicles for land transportation. Eleven industries are included here. Five sixths of the total product of the group arise from three of them, namely, the operation of repair shops of steam railway companies, the manufacture of carriages and wagons, and the building of steam railway cars. The value of automobiles made per year increased from less than \$5,000,000 in 1900 to over \$30,000,000 in 1905. On the other hand, the output of bicycles declined from \$32,000,000 to \$5,000,000 during the same period.

286. Liquors and beverages. The production of distilled, malt, and vinous liquors, of mineral and soda waters, and of malt falls within this group. From 1900 to 1905 the number of establishments increased over 11 per cent, and the value of their output more than 30 per cent. Illinois is the largest producer of distilled liquors, and

Kentucky holds second place. New York, Pennsylvania, Illinois, and Wisconsin, in the order named, lead in the production of malt liquors. California, New York, and Ohio lead in the output of wines.

287. Clay, glass, and stone products. The principal industries of this group are the manufacture of brick, tile, pottery, terra cotta, and glass. It is in the building trades that clay products are most largely used, and their consumption is on the increase. There is scarcely any variety of clay commodity that is not manufactured in the United States, although the output of the finer grades is small. Our persistence in the importation of the latter is due largely to the fact that so much delicate hand labor is required in their manufacture, which makes the industry ill-adapted to our industrial conditions. Ohio, Pennsylvania, New Jersey, New York, and Illinois, in order, are the largest producers of clay goods. There has been a marked advancement in the glass industry during the last half century, chiefly, however, in the quality of the output. Since 1900 many economies have been introduced, resulting in cheaper production. Pennsylvania produces over one third of the total value of glass; Indiana and Ohio take second and third places respectively.

288. Tobacco products. The only industries included in this group are the manufacture of cigars, cigarettes, chewing and smoking tobacco, and snuff. From 1860 to 1905 the value of the products increased from \$31,000,000 to \$331,000,000. Cigars and cigarettes account for two thirds of the aggregate value of the total output. Pennsylvania leads in the number of cigars manufactured, New York and Ohio coming next in order. New York and Virginia make about 85 per cent of the cigarettes manufactured in the United States. North Carolina, Missouri, and Kentucky are the states producing the most chewing and smoking tobacco and snuff.

289. Shipbuilding. Under this head are included the building and repairing of iron, steel, and wooden vessels, yachts, boats, barges, and scows, excepting what is done in governmental establishments. Since 1850 the value of the products has increased fourfold and the capital invested over twentyfold. This indicates that, with the transition from sail to steam, and from wooden to iron and steel vessels, large capital is necessary to develop the industry. At the present day about 85 per cent of the total capital invested in shipbuilding is in the iron and steel branch of the business.

290. Miscellaneous industries. This group includes all branches of our manufactures which could not be classed conveniently with any of the foregoing groups. There are 65 distinct industries of

greater or less importance, with a combined yearly product valued at nearly \$950,000,000. Some of the more important are those connected with the manufacture of agricultural implements, buttons, coke, electrical machinery, electrical apparatus and supplies, ice, musical instruments, lead pencils, and pens. In all there are upwards of 12,000 establishments in which are employed nearly 400,000 wage earners. More detailed information concerning this group of industries and the others already considered may be gained by consulting various publications of the Bureau of the Census, especially *Bulletin 57*.

CHAPTER XIX

TRANSPORTATION

291. Introductory. Already it has been seen (§§ 162 ff., 181 ff.) that the development and utilization of transportation facilities are necessary expedients in the struggle for existence, for neither individuals nor groups of men are entirely self-sufficient in providing for their diversified wants. The production of raw commodities as well as manufactures is, for various reasons already indicated, localized; and trade routes and vehicles of transportation must be developed to facilitate exchange. The fact that few primitive societies without some knowledge of the art of navigation have ever been known, gives evidence of its indispensability in the struggle for existence; likewise, devices for facilitating land movements have been used from time immemorial. The degree to which man has perfected the transportation system on any particular stage of the arts has depended, in a large part, upon necessity, and the further it was carried towards perfection, the more it contributed to the comfort and well-being of society. Again, it has been shown (§§ 184, 185, 192) that such natural conditions as topography, density of vegetation, etc., were the controlling factors in determining the location of early land routes. Even at the present day, when man's control over nature is so great that at times it appears to have no limit, such factors continue to be reckoned with by engineers in locating public highways, railroads, etc. Obviously, among the primary motives prompting man to develop transportation systems were the reduction of friction and the elimination of a considerable fraction of the time element in moving persons and property from place to place. The former took a great forward stride when the wheeled vehicle was invented, and, from that time to the present, modifications of the roadway to the vehicle have been in progress. In the matter of annihilating distance, so great has been the development that places which even a century ago were practically isolated from each other are now at each other's doors, as it were, on account of the evolution of the railway. Oceans are no longer barriers to trade and travel, for the development of the modern steamship enables one to journey with an ease, safety, and speed which had not

been dreamed of a hundred years ago. Moreover, the wealth of a country cannot be utilized to the greatest advantage unless there are good transportation facilities; our great iron and steel industries would still be in their infancy, were it not for the excellently organized service afforded by the transportation companies on the Great Lakes. The vast wealth in our farm lands in the central West would still be unavailable, were it not for the railways which connect those regions with the seaboard. It is a well-known fact that water carriage is comparatively cheap, and, for this reason, those countries with long, irregular coast lines, well supplied with good harbors, or possessed of navigable rivers and canals have a great advantage in developing commerce as compared with others whose geographical environment is less favorable.

292. Transportation routes of the Indians. An examination of the transportation systems of the American Indians shows many striking instances of the influence of the environment. By way of illustration let us consider for a moment the type of their water vehicle in the neighborhood of the St. Lawrence River and the Great Lakes. A glance at the map in this section of the continent and westward shows that there is an abundance of natural water ways separated here and there by portages; consequently, it was quite possible for the roving aborigines to travel hundreds and even thousands of miles by water, were their boats light enough to carry across the portages. If they had made their boats of hollowed logs as did their brethren in the region of the Caribbean Sea, the labor necessary to move them on land would have discouraged long-distance travel. But the Indians showed wonderful sagacity in utilizing for their craft the bark of the birch tree, which grew in abundance in the territory which now forms the northeastern part of the United States and southeastern Canada. Thus their canoes were made comparatively light and easy to handle. Again, in the location of their trails, which led from the Atlantic seaboard across the mountains, the Indians chose the lines of least resistance, selecting the valley of the Mohawk and the lowest passes of the mountains farther south. The influence of the physical environment is still further shown by the fact that marshes and other lowlands were avoided, the trails, in general, taking the longer but drier course around such obstacles. Many other examples of the influence of the environment upon the routes and vehicles of transportation of the Indians could be cited.

293. Colonial conditions. In considering now, with the foregoing setting, the earlier history of the American colonies, before the

westward movement of population had become important, we find that the improvements in transportation were inconsiderable and of a local character. Boats of small size were used for coastwise traffic and travel, and for similar purposes up and down the rivers. Crude roads were constructed through the forests, sometimes only wide enough for pack horses¹; for a long time the only communications to the small western settlements were the Indian trails (§ 292), along which no bulky goods could be carried; but few articles would pay for their conveyance over long distances, and so the amount of trading was small and the markets were limited in extent. In course of time, however, the trails gave way to roads and these to well-constructed turnpikes, which, for the time being, were considered adequate for trade and travel. Later canals and finally railroads were developed. With all their power the latter are already proving themselves incapable of handling the nation's products with sufficient rapidity to avoid congestion during the busy seasons; and various schemes for improving and enlarging the internal water ways are being urged (§§ 308, 309, 310).

294. Roads. Most of the colonies had legal provisions for road making, but how far these were carried out depended upon each particular district or county. Often the individual landowners were forced to cope with the problem of improving communications to widen the market for their surplus products. For a long time there was not sufficient community of interests to prompt adjoining colonies to co-operate in building intercolonial roads; moreover, lack of capital and racial and religious differences retarded the movement. Even at the time of the Revolution there was not a good road of considerable length in any part of the country, and there were no permanent bridges over the large streams. Not until after the opening of the nineteenth century was travel in carriages at all common. Soon after the Revolution considerable attention was given to the improvement of land transportation in several of the states; both private companies and state governments became interested in the matter. The Philadelphia and Lancaster turnpike was opened in 1794 and gave considerable impetus to the new movement; it was the first extensive turnpike ever constructed in the United States. During the first quarter of the nineteenth century the building of roads by private companies became a mania in the seaboard states; these were designed especially to connect the coastal cities with the more populous inland towns. The states themselves voted money, set aside the proceeds of land sales, and established lotteries to carry on the work of

connecting up the frontier settlements with roads, the prospective income from which could not prompt private capital to undertake their construction. An agitation arose for the federal government to take a hand in the matter. The earlier years of the century were ones of abundant federal revenue, and so important was the question of transportation improvements considered, that a movement was started for using the surplus in the treasury for building roads and other means of communication. While the question of the constitutionality of such an enterprise was being considered, Albert Gallatin, Secretary of the Treasury, was instructed to prepare a report showing the state of the roads, bridges, water ways, etc., of the United States, and to draw up a plan for providing the country with an adequate system of internal improvements. The report, which advocated the expenditure of \$20,000,000, was submitted to Congress a short time after the Embargo had been laid. This was a most unpropitious time, for the surplus in the treasury was fast wasting away and the whole country was in commotion; consequently, no action was taken to follow out Gallatin's plan. The only extensive transportation improvement undertaken by the government during this period was the Cumberland Road, which ran from Fort Cumberland on the Potomac to Wheeling on the Ohio; the work of construction was undertaken in 1811 and the road was completed in 1818. Later it was extended westward and completed to Springfield, Ohio; partly completed to Vandalia, Illinois; and surveyed but not definitely located to Jefferson City, Missouri. Congress appropriated the necessary funds for building the road as "advances" to be paid back out of a "two per cent fund" which was to be accumulated by the sale of public lands in Ohio, Indiana, Illinois, etc.

The building of the Erie Canal (1817-1825) (§ 296) was the occasion for the commencement of many other canals, and the mania for turnpike building subsided. Turnpikes, in most cases, were financial failures, since the tolls were insufficient to pay dividends. Still, the reduced cost of transportation and the increased value of the lands adjacent to the roads helped to offset this deficiency. Most of the roads in the United States, as originally laid out, were located with little regard for topography (cf. § 185) or drainage, since they followed the boundary lines of farms; these were irregular in the eastern states, so that often the roads were crooked and steep. Greater regularity occurred in the Middle West where the land was laid out by the government and the roads followed the section or quarter-section lines.

There are now 2,151,570 miles of public roads in the United States.¹ Of these, 108,233 miles are surfaced with gravel, 38,622 miles with stone, and 6810 miles with special covering such as shells or brick. In all, over 7 per cent of the mileage has been improved.²

When railroads were first being built it was thought that they would supplant the wagon roads; hence from about 1835 to 1890 the latter were sadly neglected. At the present time, however, the necessity of improving them is being keenly felt, for the extensive travel and traffic passing over the roads make them, in a sense, important feeders of the great railway transportation systems of the country. Besides, the invention of rubber-tired vehicles for use over considerable distances has focused attention upon the issue of road improvement.

295. Canals. As early as 3500 B.C. artificial water ways for irrigation and drainage purposes were to be found in Egypt and Babylonia. The Suez Canal (not in its present channel) was partially excavated before 2000 B.C., and the Royal Canal, between the Tigris and the Euphrates, was opened at about the same time. Under the Roman emperors several canals were constructed—one from the Rhone to the Mediterranean, another from the Tiber to the sea. After the downfall of Rome in 476 A.D., canal building seemed to languish till the beginning of the ninth century, when Charlemagne attempted to connect the Danube and the Rhine.³ In the seventeenth century the movement spread rapidly in Europe, the French being the most active. The eighteenth century saw the English engaged in the work with great vigor.

Before the invention of locks, canals could be built only on comparatively level surfaces. The Egyptians and the Chinese, however, seem to have adapted their works to the varying contours of the land by transferring their boats to successive levels by a form of inclined plane; the same device is used in China to the present day. It is not known when or by whom the lock was invented; the honor is claimed by both Italy and Holland. It is known, though, that the

¹ Figures given here are for 1904. They do not include roads in Indian Territory, Alaska, and the island possessions, nor do they include streets or boulevards in incorporated cities and towns.

² An improved road is one which "not only has been properly graded and drained, but which has been surfaced with a material or combination of materials, or to which some preparation has been applied resulting in a reasonably smooth, firm, and durable surface."

³ The Ludwig Canal now affords communication between these two rivers.

lock was in common use in both countries by the latter part of the fifteenth century, and from that time on topography ceased to be as strong a controlling factor in building artificial water ways as formerly.

296. Erie Canal. It is quite probable that the first canal in what is now the United States was built by Lieutenant Governor Colden in 1750 in Orange County, New York, for the purpose of transporting stone. Other canals were soon built; but it was not until the Erie Canal had been put into successful operation that the great impetus towards building similar works was given to other states. The prime motive in building the Erie Canal was to provide New York with a better means of communication with the growing West than any of the other Atlantic seaboard states then had; for the trade of the vast region beyond the mountains was considered as worth strenuous efforts to obtain. Consequently, the work was undertaken by the state; and the money and effort which it cost were well expended, for it contributed a large share towards making New York the metropolis of the Union. But it is not to be forgotten that the success of the Erie Canal and the failure of later projects in other states were inevitable from the beginning. The peculiar physical features of New York, making it unnecessary to overtop the mountains to reach the West, gave that state a decided advantage over all her competitors (cf. § 55). The second quarter of the nineteenth century was the great canal-building era in this country. It was confidently believed by many that canals were the final stage in the evolution of transportation. During the period just mentioned, nearly 4500 miles of works were built at a cost of about \$214,000,000. The state governments built a large percentage of the canals which were expected to be great financial successes. But the widespread political corruption, reckless financing, and an overestimation of the potential productivity of the works caused several states to go into bankruptcy in 1843. The coming of the railway contributed to shorten the period of usefulness of the canals, most of which long ago have been abandoned. The Erie is a striking example of a canal which has been able to withstand the competition of the railways, although without the improvements now in progress it was doomed. Until 1866 the canal traffic embraced 60 per cent of the freight movements across New York state. From that time the figures continued to shrink until 1895; since then they have remained nearly stationary at about 3,500,000 tons, although the railway traffic has increased enormously. Various causes account for this phenomenon; of these, one of the most important is that for the past 40 years or more no permanent

canal improvements of importance have been effected. Both the style of the boats and the method of handling their cargoes have changed but little since the canal was built; likewise the size of the channels and of the locks has not been increased since 1862. Consequently, it seems fair to say that the decline in traffic on the Erie Canal has been due, in a large degree, to a failure to improve its physical condition to keep pace with the railroads.

The state of New York has adopted a plan for rebuilding and enlarging the Erie Canal, and soon a thoroughly up-to-date artificial water way will connect the Hudson and the Great Lakes. Steam-towed barges drawing 10 feet of water, and with a capacity four times that of the largest boats used at the present time, are to be put into service. When the work is completed it is expected that the trip from Buffalo to New York will be made in 5 days instead of 10 as at present. In addition to the rebuilding of the main line, the Oswego River from its junction with the Erie Canal to Lake Ontario is to be canalized and the Hudson from Troy to Fort Edward is to be made navigable.

297. Panama Canal. The United States government is at present engaged in constructing the Panama Canal. A strip of territory 10 miles wide, known as the Canal Zone, was purchased from the Republic of Panama for the sum of \$10,000,000, and through it the canal will pass (cf. § 327). The French, who had already spent millions of dollars in an unsuccessful attempt to carry out a similar enterprise, were paid the sum of \$40,000,000 for their rights, plant, etc. According to present plans the canal is to be of the lock type with a summit level of 85 feet above the sea. Apart from the work of sanitation (cf. §§ 150, 151), the two great problems confronting the engineers are the control of the waters of the Chagres River and the piercing of the continental divide. It is hoped that the canal will be opened in 1915. The work of construction is in the hands of an Isthmian Canal Commission, the chairman of which is also the chief engineer.

RAILROADS AND WATER WAYS

298. Introductory. History does not record the name of the person who first conceived the idea of lessening friction by constructing a track of two parallel strips of wood or iron over which a wheeled vehicle could be passed. It is known, however, that crude attempts at this method of transportation were made in England in the first half of the seventeenth century. At about the same time four-wheeled

wagons took the place of two-wheeled carts. For a century and a half the rails were flanged to keep the vehicle from leaving the track. In 1789 a railway was constructed at Loughborough, England, having flat rails, the flanges being cast on the tires. For a long time the vehicles used were the ordinary road wagons. The gauge of the early railways was, in many cases, the same as the standard to-day, i.e. 4 feet 8½ inches. The motive power was gravity, horses, or even the wind acting upon sails. After the patenting of Watt's steam engine in 1769, the idea soon arose of using steam power for propulsion. A stationary engine was first used, but in time it gave way to the locomotive. It was in 1829 that the superiority of the latter was clearly demonstrated, and England claims the honor of this triumph. The Liverpool and Manchester Railway was about to be opened, and the company offered a prize of £500 for a locomotive engine that would run at a speed of at least 10 miles per hour, drawing three times its own weight. The *Rocket*, constructed by George Stephenson, carried off the honors from two other competitors; it weighed 4¼ tons and, with a load of 12¾ tons attached, ran at a speed of 29½ miles an hour on a level track.

299. Beginning of our railway era. This country, being younger and less developed economically than England, was considerably behind the latter in railroad building. As already mentioned (§ 296), the fever for canal construction was raging for most of the time during the second quarter of the nineteenth century; yet various schemes for railway building were being advanced and a few short tramways had been in operation for several years. The first important railroad in the United States was the Baltimore and Ohio, commenced in 1828; and two years later the first division from Baltimore to Elliott's Mills was opened for general transportation purposes. At first horses furnished the motive power, but very soon they were supplanted by locomotive engines. The cars were small open carriages resembling stagecoaches, but in course of time they were built much longer and came to be mounted on trucks. Later, other improvements were made which combined to minister to the comfort of the traveler.

The failure of many of the canals to fulfill the purposes for which they were constructed, and the general superiority of railroads over canals as a medium of transportation soon made it apparent that the former were destined to have a brilliant future; but it was not until after the middle of the century that their growth became rapid. The following table shows the number of miles of railway in operation in the United States for the years given.

Year	Mileage	Year	Mileage
1830	23	1900	194,262
1840	2,818	1901	198,743
1850	9,021	1902	202,938
1860	30,626	1903	207,335
1870	52,922	1904	212,394
1880	93,267	1905	217,341
1890	166,703	1906	222,571

300. Railways before 1850. Until the middle of the century the railways built were short lines radiating from the most important Atlantic seaports. Little regard was paid to connection with other lines; the linking together of local points was the prime motive in construction. At first Philadelphia was the most important center; New York had communication with the West by means of the Erie Canal (§ 296), which enjoyed a large traffic in both freight and passengers; consequently, the development of railways in that state was comparatively slow. From 1840 to 1850 the mileage increased faster in New England than elsewhere.

301. Railway consolidation. After 1850 there began a consolidation of short lines into systems.¹ This was necessary in order to meet the demands for uninterrupted travel and to avoid delays in the transportation of freight. In 1850 seven distinct companies were operating the roads connecting Albany and Buffalo; the following year their consolidation was effected, and later, by the purchase of the Hudson River Railroad and others, the New York Central system was firmly established. Similarly, the Pennsylvania Railroad Company acquired through connections from Philadelphia to Pittsburg in 1852, and later, by absorbing 200 or more other companies, there has been built up the powerful Pennsylvania system.

302. Development westward. Between 1850 and 1860 several of the so-called "trunk" lines were completed. The Erie and the Baltimore and Ohio reached Lake Erie and the Ohio River respectively in 1851. Two years later one could travel from the Atlantic seaboard to Chicago by an all-rail route. Meanwhile, railway building, stimulated by federal land grants, state subsidies, and good times, continued to be carried on with great activity in the section of the country lying north of the Ohio River and east of the Mississippi. But the panic of 1857, quickly followed by the Civil War, caused a great reduction in the mileage built. This condition lasted until

¹ Many of the facts here given have been taken from Johnson's American Railway Transportation.

1865, but by 1869 the Pacific Ocean had been reached. As early as 1834 the idea of building a railroad from New York to the Pacific was advanced, but the supposed barrenness of the West made the scheme appear undesirable. After considerable agitation, however, Congress was induced in 1862 to assist in the matter by granting liberal subsidies to two companies, the Union Pacific and the Central Pacific. The former built westward from the Missouri River, the latter eastward from Sacramento, which already was connected with San Francisco, and by 1869 the lines met.

303. Construction since 1880. During the decade ending in 1890 over 73,000 miles of railway were built. Although all sections of the country contributed to this figure, the central and western parts were particularly active in adding to their railway mileage. This was due to the rapid settlement and general material development in those regions; in many cases the railways preceded settlement and made immigration into districts hitherto inaccessible comparatively easy. Since 1893 the increase in our mileage has been rather slow. From 1894 to 1898 inclusive — the five years following the crisis of 1893 — the annual construction averaged only 1859 miles, or an increase of slightly more than 1 per cent. Following the return of prosperity in 1898, there was a gradual rise in the construction curve, and now rather more than 5000 miles of new track are added per year. Traffic on the railways has increased much faster than the mileage; from June 30, 1895, to June 30, 1905, there was a growth in ton-mileage of 110 per cent, although the trackage increased only about 20 per cent. It is estimated by some authorities that this country needs at once 100,000 miles of additional track to serve adequately the needs of the shippers. Already our railway mileage is about two fifths of that of the whole world and over one tenth greater than that of all Europe.

304. Present railway net. As shown by the table (§ 299) the official single-track railway mileage of the United States in 1906 was 222,571 miles. In addition there were 17,936 miles of second, 1766 miles of third, and 1280 miles of fourth track, besides 73,761 miles of yard tracks and sidings. Consequently, the aggregate railway mileage, including tracks of all kinds, was 317,314 miles. It was owned by over 2300 corporations. The number of persons on their pay rolls was over 1,500,000, and the wages paid was more than \$925,000,000. The par value of the railway capital outstanding on June 30, 1906, was \$14,570,421,478; the average capitalization is about \$68,000 per mile. There is no industry in the United States excepting

agriculture that equals the railways in amount of capital invested or in the value of business transacted annually. Moreover, the investments in railway property form from one seventh to one fifth of the total wealth of the country.

305. Freight rates. Along with the rapid expansion of our railways came marked improvements of all kinds, which not only bettered the service but allowed a great reduction in freight and passenger rates as well. In 1837 the charge for carrying goods per ton-mile varied from 4 to 12 or 13 cents. Some of the early charters authorized a rate of 10 cents per ton-mile on bulky articles, or of 10 cents per cubic foot measurement for a distance of 100 miles. Now the average freight rate per ton-mile is .759 cents. The figure varies greatly (from .6 cents to 1.18 cents) in different parts of the country. The average revenue per passenger-mile is slightly over 2 cents.

306. Interstate Commerce Commission. In some countries, such as Germany and Belgium, the railways are owned by the government, but in the United States they are owned by corporations. Federal supervision over interstate business is exercised through the Interstate Commerce Commission, which was created in 1887. At present it is composed of seven members, only four of whom may belong to the same political party. In general, the commission endeavors to prevent unjust discrimination in favor of certain shippers and places, prescribes maximum rates if, upon complaint, the rate charged is shown to be unreasonable or unjust, and supervises the accounting of the railways to secure uniformity and to bring clearly before the public all the various transactions of the railway companies.

307. Great Lakes. The Great Lakes are our principal inland water way and the scene of the greatest volume of shipping upon any large body of inland water in the world. They have a total navigable length of 1410 miles. They are connected with the Atlantic Ocean by the St. Lawrence River, which is navigable for vessels of 14 feet draft from Lake Ontario to Montreal, and from that point to the ocean by steamers of much larger size. The approximate elevations of the lakes above sea level are as follows: Superior, 600 feet; Michigan and Huron, 580 feet; Erie, 570 feet; Ontario, 245 feet. The rapids in the Saint Mary's River connecting Superior and Huron are overcome by the Sault Ste. Marie canals — one on the American, the other on the Canadian side. The former has more traffic than any other canal in the world. In 1907 the freight which passed through the two canals aggregated 58,000,000 tons. The canal on the Canadian side now carries from 20 to 25 per cent of the total

traffic. The Welland Canal, 14 feet deep and 27 miles long, connects lakes Erie and Ontario. The rivers flowing into the Great Lakes are short and of little commercial value except for the harbors at their mouths.

The size and character of our merchant fleet on the Great Lakes becomes apparent by an examination of its statistics. On June 30, 1907, the gross tonnage was 2,439,741,¹ or more than one third of our total merchant marine. Nearly six sevenths of this consists of steam vessels, while numerous so-called sailing crafts are usually towed, the sails being used largely to facilitate steering. While the average size of the steamers is approximately 1000 tons, those constructed during recent years are as large as some ocean liners. For example, in 1907 there were 36 steel steamers of 1000 or more gross tons, built for the trade of the Great Lakes, and their average size was 6049 tons. In the same year was constructed the largest vessel ever built on the Lakes, *Le Grand S. De Graff*, 585 feet long, 60 feet beam, and of 7971 gross tons; twenty years ago the largest transatlantic liner, the *Servia*, had a tonnage of but 7392.

The enormous traffic on the Great Lakes, which calls into service this large, well-equipped fleet, is better understood by a consideration of the natural wealth and of the manufactures of the territory which it serves. Lakes Superior and Michigan are near great resources of iron ore, copper, cereals, and lumber, while the anthracite and other eastern coal fields are near enough to Lake Erie to make it profitable to send shipments westward by water. Ninety per cent of the lake traffic is confined to four articles — iron ore, grain and flour, lumber, and coal. The first-mentioned commodity forms about one half of the total yearly tonnage, and six ports on Lake Superior, viz., Duluth, Two Harbors, Superior, Ashland, Escanaba, and Marquette, handle most of the ore; in fact, one half or more is loaded at the first two ports. Ninety per cent of the ore has for its destination a series of ports on Lake Erie, of which Ashtabula, Cleveland, and Conneaut are the leading ones. The only important receiving point not on Lake Erie

¹ The increase in the tonnage of the fleet on the Great Lakes has been steady and rapid as shown by the following figures:

Year	Tonnage	Year	Tonnage
1880	605,102	1903	1,902,698
1885	749,948	1905	2,062,147
1890	1,063,063	1906	2,234,432
1895	1,241,459	1907	2,439,741
1900	1,565,587		

is Chicago. Wheat goes east mainly from Duluth, Superior, Chicago, Milwaukee, and Toledo, and is received mainly at Buffalo, although Erie and Ogdensburg take large shipments. Lumber is sent from many ports, Duluth being the principal one, and Chicago is the great receiving point. Buffalo is the leading shipping point for anthracite coal, although Erie is important; this commodity is distributed to many cities along the shores of lakes Michigan and Superior. Soft coal goes west from many places along Lake Erie, and is laid down at receiving points, principally Milwaukee, Superior, and Duluth, along the two western lakes. Chicago gets most of its soft coal by rail.

The organization of the transportation service on the Great Lakes has been so perfected that the average freight charge per ton-mile is scarcely more than one tenth that of the average railroad rate for the whole country (cf. § 305). The saving in transportation charges in shipping by water is enormous: iron ore from the Lake Superior region is taken to the smelting works of the East for approximately 60 cents per ton; while a few years ago the charge for a similar service was \$3. Freight shipments on the lakes generally are over long distances; nearly all the steamship lines operate on two or more lakes. The eastbound tonnage is about five times that of the westbound.

308. Inland water ways other than the Great Lakes. This country was bountifully endowed by nature with inland water ways. Not only do they surpass those of every other country in extent, but their geographical distribution is such that their utilization for commercial purposes is made easy. The Mississippi and its tributaries alone furnish 16,000 miles of water way. In all there are 25,000 miles of navigated rivers and an equal additional mileage that can be made navigable. Besides, there are about 2000 miles of canals in operation. The sounds, bays, etc., that are capable of being converted into a continuous inner route for coastwise traffic along the Atlantic and Gulf, by connecting them up with something less than 1000 miles of canals, are approximately 2500 miles in extent. If there be added to the above the 1410 miles of transportation route furnished by the Great Lakes, it is seen that all of the present and prospective water ways of the country have a combined length of over 55,000 miles. At the present day only about one half of the entire mileage is used for navigation.

In spite of the ever-increasing demands made upon the railways for handling freight, the river traffic has actually declined during

recent years ; the tonnage moved on the Mississippi and its tributaries was less in 1906 than in 1889. With the decline of traffic there has been a falling off in the character of the service. Recent investigations have shown that railway competition has been responsible, to a large degree, for driving commerce from our inland water ways ; yet, in years of good crops, the railways cannot adequately handle the traffic. A graphic description of the present transportation situation has recently been given by a writer who says we are "trying to force a three-inch stream of commerce through a two-inch pipe of railways." It is this condition of affairs which has called forth a widespread demand for the improvement and extension of the river systems to supplement the railways. In view of the rapid expansion of the country's industries, so serious is the transportation question becoming that it may be justly regarded as one of the greatest national problems. The movement has resulted in the formation of numerous water-ways associations, some with local, others with national, aims.

309. Water-ways associations. Some of the more important of these are: The Western Water-ways Association, which aims to unite all streams in the Mississippi valley ; The Interstate Mississippi River Association, which is concerned with the levees of the Mississippi from Cairo to the Gulf ; The Ohio Valley Improvement Association, whose object is to secure the deepening of the Ohio River to nine feet from Pittsburg to Cairo ; The Upper Mississippi River Improvement Association, concerned with securing good navigation from St. Louis to St. Paul ; The Lakes-to-the-Gulf Deep Water-way Association, which advocates connecting Lake Michigan with the Gulf of Mexico by a channel 14 feet deep ; The Interstate Inland Water-way Association, which desires to have the Mississippi and the Rio Grande joined by a nine-foot channel connecting up the water ways along the coasts of Texas and Louisiana ; and The Atlantic Deeper Water-ways Association, agitating for a through inland route for naval and merchant vessels from Boston to Jacksonville, Florida. Perhaps a more comprehensive organization than any of the above is the National Rivers and Harbors Congress formed in 1901. It is truly a national body both with reference to membership and programme ; it proposes the improvement of no particular stream, but it endeavors to organize all friends of water ways in a movement designed to induce Congress to adopt a policy that will bring about eventually the improvement of every important water way throughout the length and breadth of the country. To this end it desires an annual appropriation of \$50,000,000.

310. Inland Water-ways Commission. The most recent development has been the appointment by the President of the United States, in March, 1907, of an Inland Water-ways Commission designed to bring together in one body experts in all problems relating to water ways. The report transmitted to Congress in February, 1908, contained the following among other recommendations :

"That hereafter plans for the improvement of navigation in inland waterways, or for any use of these waterways in connection with interstate commerce, shall take account of the purification of the waters, the development of power, the control of floods, the reclamation of lands by irrigation and drainage, and all other uses of the waters or benefits to be derived from this control.

"That any plans for improving the inland waterways shall take account of the present and prospective relation of rail lines to such waterways, and shall ascertain, as far as may be, whether such waterways when improved will be effectively used in the face of railway competition; and that the relation between railways and waterways be further examined with the purpose of devising means of rendering the two systems complementary and harmonious and making such fair division of traffic that rates and management may be coordinated economically and with benefit to the country."

311. Merchant marine in general. Our navigation laws require that a vessel must be measured and inspected by an official of the Bureau of Navigation in the Department of Commerce and Labor before it may be put into service. "Registered" vessels are those engaged in foreign trade; "enrolled" vessels are those employed either on our inland waters or in coastwise traffic. If the craft is of less than 20 tons' measurement it is "licensed." All vessels flying the American flag are required to be built in this country;¹ in other words, we do not have "free ships" as is the case in England.

The United States stands second among the countries of the world in tonnage of merchant marines. On June 30, 1907, the figure stood at 6,938,794 tons² distributed as follows:

SERVICE	TONNAGE
Foreign trade	861,466
Coasting trade	6,010,658
Cod and mackerel fisheries	56,990
Whale fisheries	9,680
Total	6,938,794

Sailing vessels, including canal boats and barges, number 14,861; steam vessels, 10,050. The tonnage of the latter is nearly double that of the former, the actual figures being 2,659,426 and 4,279,368. Almost half of the tonnage (3,440,697)³ is owned on the Atlantic and Gulf coasts, and more than one third of the whole (2,439,741) is owned on the Great Lakes; 886,840 tons⁴ are owned on the Pacific coast, and the balance, 171,516 tons, on the western rivers.

312. Merchant marine in the foreign carrying trade. Our merchant marine engaged in the foreign carrying trade is, at present,

¹ There are minor exceptions to this rule.

² Includes Hawaiian and Puerto Rican vessels.

³ This figure includes Puerto Rico.

⁴ This figure includes Hawaii.

comparatively small. We are almost entirely dependent upon other countries, some of which are our commercial rivals, as carriers for our exports and imports. During the past 10 years the proportion of the foreign trade carried in American vessels has averaged less than 10 per cent a year. The present tonnage is actually less than it was in 1810, when the total foreign commerce was only \$152,000,000, or one twentieth of what it is to-day. The fleet engaged in the foreign carrying trade was larger in 1861 than in any year before or since, the figure being 2,496,894 tons. The causes usually assigned for the decline after the Civil War are: a change of policy regarding ship subsidies, by which the ocean mail law of 1845 was made ineffective (this was due to the merchant-marine question becoming an issue in sectional strife); internal-revenue taxation and high tariffs, which burdened the shipyards; and the extraordinary development of industry and the opening up of the West that came soon after the Civil War. It should be stated in passing that such causes are far from satisfactory in explaining the phenomenon, but the question is too involved and requires too lengthy a discussion to be entered upon in this place.

313. The coastwise fleet. The coastwise fleet presents an entirely different picture, for only American vessels may engage in this trade. This provision was made by a law of 1817, although, since 1789, but few foreign vessels have ever been engaged in coastwise traffic. This was due to the protection given to Americans by an act of Congress of July 20, 1789, which provided that, upon entering an American port, the tonnage duty payable by an American-built and -owned ship should be 6 cents per ton, while 30 cents per ton was required to be paid by American-built and foreign-owned boats, and 50 cents per ton by ships both built and owned abroad. Moreover, American vessels engaged in the coastwise service were required to pay this tax but once a year, while foreigners must pay it at every entry. This law practically closed our coastwise traffic to foreign vessels, although, as mentioned above, legislation to this effect was not passed until 1817. The latter law has stood from that day until this; consequently, the growth of the coastwise fleet has been automatic, since, unless trade is to be considerably hampered, the coastwise fleet must increase to keep pace with the economic expansion of the country.

314. Coasting laws of the United States. The coasting laws of the United States apply to the Great Lakes and inland rivers as well. Foreign vessels are not permitted to trade above New Orleans. Furthermore, the act of Congress made effective on June 14, 1900, in

providing a government for Hawaii, while it admitted Hawaiian vessels to American registry, at the same time extended the coasting laws of the United States to Hawaii, thus restricting the trade between these islands and the United States to American vessels. Similarly, when a civil government was provided for Puerto Rico by act of April 12, 1900, the same regulation of trade was established as in the case of Hawaii. With reference to the trade of the Philippines, it is, at present, on the same basis as regards shipping as is the trade between the United States and foreign countries. But a law of April 30, 1906, provided that after April 11, 1909, no merchandise should be carried between the United States and the Philippines except in American vessels, and that foreign vessels should not transport passengers between the two countries either directly or by way of a foreign port under a penalty of \$200 per passenger. This law was repealed, however, by an act of April 29, 1908.¹

¹ The tonnage of our merchant marine in both the coastwise and foreign trade for successive decades is shown in the Appendix, Table XVIII.

CHAPTER XX

COMMERCE

315. Introductory. The study of man in his most primitive relations, where his life conditions are but little removed from the plane of the brute's, shows that his wants are few and that these are supplied largely from the immediate environment. In the progress upwards towards civilization man's wants become diversified, but natural riches are unevenly distributed over and within the surface of the earth; consequently, larger areas come to be called upon in the satisfaction of the new desires. In this and in other ways already considered (cf. §§ 181-182, 193-194) commerce arises. Whether it be under primitive or modern conditions, those things which are desired but which are not produced at home must be obtained elsewhere, and it is commerce which accomplishes the redistribution of the products of the earth. When we come to a consideration of modern commerce, it may be wondered why countries continue to import vast quantities of raw products which are adapted to their own soil and climatic conditions; or why millions of dollars continue to be paid out annually for manufactures which apparently could be produced at home. It would involve a long and intricate discussion to enter into an explanation of these phenomena which would be at all satisfactory; for, under the complicated conditions of modern production and distribution, a variety of factors whose influences are difficult to trace would have to be considered. One of the best explanations, however, is found in the economic doctrine of comparative costs. Nations differ greatly in many respects, which give them comparative advantages or disadvantages in the matter of production. "Adam Smith shrewdly perceived that the causes of the advantages one country has over another are not all of the same kind; but he pointed out with truth that, given the advantages, they determine the course of trade."¹ Among the factors to be reckoned with here are geographical differences, personal aptitudes, differences in skill, knowledge of the arts, mechanical training, etc.

¹ Taussig, *The Tariff History of the United States*, pp. 407-408.

A convenient classification of commerce distinguishes domestic or internal trade from foreign trade. Under the former as applied to the United States are included intra- and inter-state trade; besides, commodities brought into this country from Alaska, Hawaii, and Puerto Rico, as well as shipments thereto from the United States, are considered as movements in domestic trade; that is to say, the possessions named are customs districts of the United States. On the other hand, goods imported into and exported from these non-contiguous territories in their trade with foreign countries are reckoned as a part of the foreign trade of the United States. In general, foreign commerce refers to the exports to and imports from abroad, but trade between this country and the Philippines is included in the figures for foreign commerce.

It is of course impossible to secure complete and accurate statistics of the world's commerce. It is estimated that international trade alone now exceeds \$26,000,000,000 annually. It is evident that both it and the domestic commerce of individual countries are increasing rapidly both in volume and value. This is due not only to the increase of population but also to the advancement of the standard of living in most countries, which increases the per capita consumption. Moreover, the development of transportation facilities, reduction in freight rates, better organization of trade and industry, and large scale production have combined to reduce the cost of commodities and to widen the market for many articles formerly beyond the reach of the masses. Not only has the volume of domestic commerce been swelled in this way, but that of foreign trade as well.

316. Domestic trade. The domestic trade of the United States far surpasses the foreign trade in volume and importance; it is estimated that the former has an annual value of \$25,000,000,000, or more than seven times the value of the latter. Or, to add another comparison, it is nearly as large as the world's international commerce. Our domestic trade assumes such large proportions owing to the high standard of living, the extent of settled territory, the abundance and diversity of natural resources, the good quality of many of the manufactures, and our comparative independence of the rest of the world for all materials of commerce excepting luxuries and certain high-grade manufactures. This is why the average expenditure of our people for domestic goods is many times that for foreign commodities.

317. Foreign commerce in general. The development of foreign commerce during the past century has been enormous. In 1800 the

combined exports and imports of the whole world were less, by \$100,000,000, than the exports of the United States in 1905. From 1800 to 1850 the increase was 166 per cent; from 1850 to 1905 it increased 562 per cent. Some of the causes for this great expansion have been pointed out in the foregoing discussion (§ 315)

The foreign trade of the world by continents and the share of the United States therein is shown by the table in the Appendix.¹ From this it appears that Europe is the great center of both the export and the import trade, commanding nearly two thirds of the whole. About 10.5 per cent is in the hands of the United States; so that Asia, Africa, Oceania, South America, and North America (excluding the United States) together have about one fourth of the world's trade (cf. §§ 174, 175, 193, 198). Roughly speaking, Europe depends upon the rest of the world, to a large degree, for food and raw materials, while her dense population engages in industry to create the purchasing power for the large importations. During the past quarter of a century or more the foreign trade of the United States has grown to enormous proportions. Even as late as 1870 its value was only \$829,000,000, of which the imports were more than half. For the calendar year 1906 the value of the foreign trade passed for the first time the \$3,000,000,000 mark. For the fiscal year which ended June 30, 1907, it was valued at \$3,315,272,502, of which the exports alone amounted to \$1,880,851,078, nearly five times their value in 1870.

The rapid strides which this country has taken in developing foreign commerce place her among the three leading commercial nations. The following figures taken from "Daily Consular and Trade Reports" bring out some interesting relations regarding the trade of the rival countries in 1906.

DESCRIPTION	UNITED KINGDOM	GERMANY	UNITED STATES
Foreign trade			
Imports for home consumption .	\$2,544,327,900	\$1,910,227,700	\$1,313,667,900
Exports of domestic produce . .	1,828,212,600	1,490,366,600	1,797,320,100
Total trade	\$4,372,540,500	\$3,400,594,300	\$3,110,988,000
Estimated population on June 30 .	43,659,000	61,337,000	84,154,000
Foreign trade per capita			
Imports for consumption . . .	\$58.27	\$31.14	\$15.59
Exports of domestic produce . .	41.88	24.30	21.37
Total trade per capita . . .	\$100.15	\$55.44	\$36.96

¹ See Table XIX.

318. Imports. Our imports of¹ merchandise in the fiscal year ending June 30, 1907, were valued at \$1,434,421,425. Of this amount, crude materials for use in manufacturing constituted 33.25, per cent; manufactures ready for consumption, 25.39 per cent; manufactures for further use in manufacturing, 19.11 per cent; foodstuffs partly or wholly prepared, 11.06 per cent; foodstuffs in crude condition, and food animals, 10.44 per cent; and miscellaneous goods, .75 per cent. It may be said that these figures are typical of the returns for the past few years. The tendency, however, is to import relatively less foodstuffs and manufactures ready for consumption, and to increase the importations of semi-manufactured goods and of crude materials for manufactures. Some of our most important imports are sugar, hides and skins, coffee, drugs, chemicals, dyes, raw silk, vegetable fibers, rubber, and fruits. One third or more of all the imports are from tropical or semi-tropical countries (cf. §§ 175-180, 197-198):

319. Exports. Not only has the export trade grown at a rapid pace during the past few years, but its character has changed as well. To the latter point attention will shortly be given. At the present time,¹ crude materials for use in manufacturing form 32 per cent of the total value of the exports. Manufactures, including those ready for consumption and those for further use in manufacturing, form 39.92 per cent, their respective figures being 25.93 and 13.99 per cent. Foodstuffs, partly or wholly prepared, constitute 18.65 per cent, and those in the raw state, including food animals, 9.03 per cent, leaving only .4 per cent for miscellaneous commodities.

Agricultural products have always formed and still continue to represent the major share of the export trade, although they are relatively on the decrease. Their value at five-year periods from 1880 to 1905 inclusive constituted the following percentages of the total exports: 83, 73, 75, 70, 61, and 55. On the other hand, manufactured and semi-manufactured goods are on the increase; during the periods just mentioned above their values were the following percentages of the whole value of the exports: 12, 20, 18, 23, 32, and 36. At the present day about 40 per cent of our exports are manufactures, and the time is rapidly approaching when the figure will be 50 per cent or more.

320. Movements for expansion of export trade. The change in character which the export trade has undergone in comparatively recent years has called forth a conscious movement for its expansion.

¹ Figures are for the fiscal year ending June 30, 1907.

So long as agricultural and other raw products formed the greater bulk of the foreign shipments, the trade could, in a large degree, look after itself; for foreign countries stood in need of such commodities and a ready market was generally available. But when a large percentage of manufactured goods are found in our foreign shipments, the problem of selling these goods in competition with such advanced nations as Great Britain and Germany becomes a difficult one to handle. These countries have been exploiting foreign markets for years, and their export trade is skillfully organized. To cope successfully with the problem of expanding foreign commerce, several movements are already in progress. Among these are the reform of the consular service; organized efforts by Chambers of Commerce and Boards of Trade; investigations of trade conditions in foreign countries by special agents of the Bureau of Manufactures in the federal Department of Commerce and Labor; and the creation of a National Council of Commerce.¹ The latter was instituted at the instance of former Secretary Straus and is composed of one member from each of the leading commercial and industrial organizations representing the principal lines of commerce and manufacture in every section of the United States; a committee comes into direct contact with the officials of the Department of Commerce and Labor. In this way there has been created a connecting link between the federal government and the business world, so that now team work is possible in expanding foreign commerce. The same purpose is accomplished in Germany by an Imperial Consultative Board created in 1898 (cf. § 399).

¹ See an article on "The Extension of American Commerce" by A. L. Bishop, in the *Atlantic Monthly* for February, 1909.

CHAPTER XXI

FOREIGN POSSESSIONS OF THE UNITED STATES

The non-contiguous territory of the United States consists of Alaska, Hawaii, the Philippines, Puerto Rico, Guam, Tutuila, and the Panama Canal Zone. Their areas total 716,555 square miles and their population is nearly 10,000,000.

321. Alaska. Area, 590,884 square miles; population, 85,000 (estimate). This vast territory equals the combined area of New England, the North Atlantic States, and of the Carolinas, Georgia, Florida, Alabama, Mississippi, and Tennessee. From Seattle to the nearest point in Alaska the distance is less than from New York to Cincinnati; from Seattle to the most remote point the distance is about the same as from New York to San Francisco.

The country was purchased from Russia in 1867 for \$7,200,000. The United States became interested in Alaska about the time of the discovery of gold in California, when an important trade in fish, lumber, and ice between San Francisco and Alaska was developed. Commercial companies were formed to handle the trade, and a partial knowledge of the resources of the country was acquired. This was one of the reasons why Secretary Seward, in spite of much opposition and some ridicule, favorably considered the purchase of Alaska when such a proposition was made by the Russian ambassador at Washington in 1864.

It is erroneously believed by many that the whole country is a frozen desolate waste, entirely unsuitable for agricultural purposes. This is of course true of large areas, but as a matter of fact one can travel from one end of the Yukon to the other in summer not only without encountering snow, but amidst a variety of luxuriant vegetation consisting of forest trees, flowering plants, and other flora such as wild raspberries, currants, and cranberries. Such products as wheat, oats, barley, potatoes, turnips, and small fruits are so well matured at the experiment stations at Sitka, Rampart, etc., that they compare favorably with similar products grown in the United States. It seems fair to say that, in the southern and southwestern parts of the country, where the climate is tempered by the currents and winds of the Pacific (cf. § 19), agriculture is comparatively easy.

The sources of Alaskan wealth at the present time are furs, fish (cf. § 248), and ores. Besides these, the supplies of timber are important, especially in the southeast where dense forests of spruce, hemlock, Sitka cedar, and red cedar occur. As to minerals, copper, coal, and gold are found in abundance.

The back country is by nature most inaccessible; the region is so rugged for 100 miles or more from the Pacific coast that "it is almost as cheap to build a railroad as to build a wagon road." The rivers, of which the principal is the Yukon, empty into seas closed by ice for seven months of the year. The country is being pierced with railroads running inland from the ice-free harbors on the Pacific; and there are three or four passes over which roads can be constructed leading to the mines and the fertile plains.

The trade of Alaska is almost entirely with the United States. In 1907 the value of merchandise brought into Alaska was \$19,537,000, and of this amount over sixteen seventeenths came from the United States. The exports of the country were valued at \$13,644,884, and over eight ninths of them went to the United States. The principal items were canned salmon, copper ore, and furs. Gold shipments were made to the value of \$16,912,000.

322. Hawaiian Islands. Area, 6449 square miles; population, 199,000 (estimate). These islands, of which there are eight principal ones, are in the torrid zone and are at the "crossroads of the Pacific" (cf. § 191). They came under the flag of the United States in 1898. They are in a direct line between Panama and Japan, and are in the path of the trade routes between San Francisco and the Philippines, and between Sydney and Seattle. Several lines of steamers plying between the Occident and the Orient call at Hawaii; thus with the development of transpacific trade, this group of islands must grow in strategic and commercial importance. Lying in the belt of the northeast trade winds, they have a salubrious and equable climate. The soil is of volcanic origin and is very fertile; cultivation of the sugar cane (§ 405) is the principal industry, and about 200,000 acres are devoted to this crop. The islands are scarcely surpassed by any region in the world in the employment of improved methods in sugar culture and in the yield of cane per acre. Steam plows are used in preparing the land for the crops; private steam railways take the cane from the plantations to mills which are equipped with all modern devices. Some of the mills have cost over \$1,000,000. A great drawback to the further development of the sugar industry is the lack of labor to cultivate the cane (cf. §§ 175 ff.). Efforts are being

made to develop other industries so as to insure a more permanent commercial prosperity. The sale of fruits such as pineapples, bananas, alligator pears, and mangoes is increasing; coffee, tobacco, sisal, and rubber can be produced with profit.

The over-sea trade is largely with the United States and totals less than \$50,000,000 annually. Merchandise to the value of nearly \$30,000,000 is sold yearly, about 95 per cent of which is sugar and comes to this country. Shipments are made to San Francisco where much of the sugar is refined, though some is sent overland to the New York refineries. It is cheaper, however, to send the raw commodity around Cape Horn to New York, so that much of the sugar goes by this route, although it takes from two to four months to make the trip (cf. § 189).

323. The Philippine Islands. Area, 115,026 square miles; population, 8,000,000 (estimate). There are about 2000 islands in this group, which extends roughly from Formosa to Borneo. Luzon and Mindanao are the largest, the former nearly matching New York state in size; the whole group is equal in area to the New England States, plus New York and New Jersey. These islands were under Spanish rule from about 1580 until 1898. Being situated between the 4th and 21st parallels of north latitude, the climate is tropical. The soil is of volcanic origin and is fertile. In general, the islands present a rugged appearance, mountains and valleys alternating, the latter being well watered.

The Philippines are capable of producing large quantities of products such as sugar, coffee, tea, cacao, rubber, fibers, tobacco, and fruits, that is, those commodities which, at the present time, figure extensively in our import trade. Consequently, this group of islands and the United States are natural trading areas (cf. § 197). But the lack of internal transportation facilities has hitherto been a serious obstacle to economic development. Several hundreds of miles of improved roads have been built since 1898; about 200 miles of railway have been constructed on the island of Luzon, extending northward from Manila to Dagupan, and concessions have been granted for the construction of several hundreds of miles more.

The products are mostly agricultural; rice is the leading crop, and the system of culture is extremely primitive. At present the most important product for export is Manila (§ 223), which ranks high among the hard fibers of the world for manufacturing purposes; the fiber is from 6 to 12 feet in length, and the best grade is of a light buff color. It is of special value for ships' cables and other marine

cordage, since, besides being strong and flexible, it does not rot easily when exposed to salt water. The output has increased rapidly in recent years, and at present this commodity forms about two thirds of the total value of the merchandise exported. Sisal (§ 409), now grown almost exclusively in Mexico, promises to become an important product in the Philippines.

Sugar ranks next to hemp among the products of the Philippines, although copra (the dried kernel of the cocoanut), in some years, stands second in the list of exports. Tobacco, introduced by Spanish missionaries in the latter part of the sixteenth century, comes next in importance; it is grown most extensively in the northern part of Luzon. Comparatively little is exported, as the home consumption is large. Previous to 1890 coffee was a relatively important source of wealth, but since that date the devastation of the plantations by insects and plant disease has caused a rapid diminution in the quantity produced; the quality is said to be especially good, comparing favorably with that of Java.

According to the Philippine census, 70 per cent of the area of the archipelago is covered with forests. Woods suitable for cabinet work, veneering purposes, and ship and house building are found in great profusion; the same is true of gum-producing trees. The mineral resources have never been exploited, although deposits of gold, copper, coal, and iron are known to exist.

The foreign carrying trade is largely in the hands of the British, who handle about 60 and 75 per cent respectively of the imports and exports. Next in order are Spain, Germany, and the United States; the latter carries about 9 per cent of the imports and a smaller proportion of the exports.

The foreign commerce of the Philippines is small. Crude methods of production, lack of transportation facilities, and scarcity of capital account in part for present conditions. Although the area of the group is eighteen times that of the Hawaiian Islands, and the population forty times as large, the exports of the Philippines are but little greater in value than are those of the Hawaiian Islands. About \$30,000,000 is their average value, and the United States takes less than one third. The United Kingdom, France, Spain, and China are the next largest purchasers. The principal imports are rice, flour, dress goods, wines, coal, and petroleum; their combined value nearly equals that of the exports, and the commodities come from many lands. The largest purchases are made from England, although the United States is a close second, supplying nearly 20 per cent of the total.

Australasia is coming to the front rapidly in the import trade, especially in the flour and coal business.

324. Puerto Rico. Area, 3435 square miles ; population, 1,000,000 (estimate). Puerto Rico was ceded to the United States by Spain in 1898. It is the most easterly of the four large Antilles (Cuba, Haiti, Puerto Rico, and Jamaica), being 450 miles east of Cuba. The 18th parallel of north latitude runs along its south coast. Its greatest length is 112 miles, its average width 36 miles. It is somewhat less than three times the size of Rhode Island. The density of population is about 290 to the square mile, which is greater than that of any of the states of the United States excepting Massachusetts (349) and Rhode Island (407). The prevailing occupation is agriculture. The conditions under which the great mass of the people live account for the possibility of so dense a population on the agricultural stage. No fuel is needed for any purpose except cooking, and this can be gathered easily ; the house is a mere framework of poles covered with palm leaves or grass ; clothing is both scanty and made of the cheapest material ; the diet is largely vegetable, consisting of rice, bananas, vegetables, etc., with little or no meat (cf. §§ 147, 175-179, 197). A range of mountains, the highest point on which is 3790 feet, runs due east and west, i.e. lengthwise of the island, at a distance of about 12 miles from the south shore. Much of the soil is a red clay, extremely tough and sticky. These qualities account for the fact that the steep deforested mountain slopes have not been deprived of their soil. Despite their disadvantages, these declivities are cultivated ; in some cases the best crops of coffee and tobacco are raised on slopes so abrupt that cultivation, even with a hoe, is possible only by grasping a tree with the left hand. Puerto Rico is free from great extremes in temperature. The highest temperature recorded is 100.8° F. and the lowest 56.1° F. An important climatic factor is the constant trade wind, which brings abundant rainfall and affords a constant supply of cool air.

Towards the close of the last century coffee was the principal product. Over 40 per cent of all the cultivated land was devoted to this crop. Within recent years sugar has been leading, although the two industries do not compete with each other. The two productive areas do not overlap, for coffee grows best in the highlands and sugar in the lowlands. The decline in coffee production was due to a combination of causes, chief among which were overproduction, partial loss of the Spanish and French markets on account of the imposition of high duties, the change in the monetary standard,

and a violent hurricane in August, 1899, which destroyed two thirds of the coffee crop. As the coffee tree takes about five years in maturing so as to bear fruit, it can be seen that the last cause mentioned must have had serious results.

The increase in sugar production since Puerto Rico was taken over by the United States has been due, in a large degree, to the fact that the sugar was admitted free of duty. Enterprising Americans have recently bought lands along the coasts and turned them into sugar plantations, and this has contributed greatly towards increasing the crop. Besides, old processes of manufacture have been supplanted by more modern ones, so that a larger percentage of sugar is obtained from the cane. The production of tobacco is increasing rapidly, especially in the valleys of the interior where the crop is grown under cheesecloth; the best quality is raised on soils which are not in demand for other crops. Thus it is seen that there is little, if any, competition among the three leading crops of the island.

The foreign trade of Puerto Rico has undergone great changes since the island came under the flag of the United States. In 1895 the latter controlled only 21 per cent of the combined export and import trade of Puerto Rico; whereas in 1907 the figure was 85 per cent. The annual value of the imports and exports of merchandise totals over \$55,000,000, there being a slight balance in favor of the former. Sugar now forms 55 per cent, coffee 17 per cent, and tobacco 4 per cent of the value of the exports. The leading imports are rice, cotton cloth, machinery, and fish.

325. Guam. Area, 210 square miles; population, 10,000 (estimate). This is the largest island of the Ladrões group, and was acquired from Spain in 1898. It is said to be thickly wooded and fertile. Cultivation is done in the most primitive manner; plows are unknown, the hoe being the only farming implement used. Tropical fruits are abundant; copra is the principal export, and the trade is largely with other countries than the United States. The island is used as a coaling and cable station.

326. Tutuila group. Area, 77 square miles; population, 4000 (estimate). Tutuila, one of the Samoa Islands, has an excellent harbor called Pago-Pago. As yet it is of little commercial importance, but it is used as a coaling station, and in time may be an important port of call for transpacific steamers. Its principal export is copra.

327. Panama Canal Zone. This territory was acquired by treaty from the Republic of Panama in 1904, for the purpose of facilitating the construction of the Panama Canal (§ 297). It extends

5 miles on each side of the center of the canal, although the cities of Colon and Panama and their adjacent harbors were not included in the grant. In accordance with the terms of the treaty mentioned, the Panama Canal Zone technically includes not only this territory, but it also reaches out from the land to a distance of three marine miles from mean low-water mark in the Caribbean Sea and in the Pacific Ocean as well. Furthermore, there was granted to the United States in perpetuity "all islands within the limits of the zone . . . and . . . the group of small islands in the Bay of Panama, named Perico, Naos, Culebra, and Flamenco." The department of civil administration of the Isthmian Canal Commission is charged with the duty of administering the civil government within the zone.

THE BRITISH EMPIRE

CHAPTER XXII

THE BRITISH ISLES

328. The Empire in general. The British Empire embraces about one fifth of the land area of the globe, or over 11,000,000 square miles. Its population is over 400,000,000, or over one fourth that of the world. It consists of the United Kingdom and a great number of colonies and dependencies in all parts of the world. The leading divisions of the Empire with their approximate areas and populations are as follows :

NAME	AREA IN SQUARE MILES	POPULATION
British Isles	121,390	44,539,000
Dominion of Canada	3,746,000	6,154,000
Australia	3,065,000	4,572,000
New Zealand	105,000	942,000
British India (including Native States) . .	1,767,000	294,317,000
British South Africa	1,230,000	8,000,000
West African colonies	487,000	18,017,000
Other African possessions	382,000	8,605,000
British Guiana	90,000	298,000
Borneo	73,000	660,000
Newfoundland	163,000	234,000
West Indies and Bermudas	12,000	1,760,000
Ceylon	25,000	3,988,000

In addition to these there should be mentioned various strategic possessions and others of more or less importance such as Gibraltar, the islands of Malta and Goza, the Straits Settlements, Hongkong, Aden, Socotra, Cyprus, Mauritius, the Falkland Islands, South Georgia, British Honduras, a part of New Guinea, the Fiji Islands, etc. Egypt and the Egyptian Sudan also are, to all intents and purposes, under British control. The mother country is very small as compared with some of the possessions. It is about one thirtieth the size of Canada, one twenty-fifth that of Australia, and one eleventh that of India.

A glance at the map¹ will show that the various parts of the Empire are divided by the oceans. Time was when this constituted a serious drawback for purposes of administration and commerce. But the great advances made in developing ocean transportation, postal, telegraph, and cable systems during the past hundred years have tended to overcome these difficulties. Great Britain controls but a small proportion of the trade of some of her possessions, i.e. the Empire does not form an economic unit; in these days trade is more likely to follow the price list than the flag. Moreover, the mother country and many of the territories which she controls are not natural trading areas (cf. § 197). However, a movement has been in progress to consolidate the Empire along the lines of trade by a system of preferential tariffs. This is a part of the so-called "Chamberlain scheme."

329. The British Isles. Introductory. This group of islands, representing the mother country of the Empire, is situated at the gateway to Europe between the parallels of 50° and 60° north latitude. They are in a much higher latitude than is often supposed, receiving the same amount of heat from the sun as southern Siberia and Labrador. If the climate were not tempered by certain modifying influences (cf. § 130), it would be unfavorable for the extensive production and commerce which have characterized these islands for centuries. Their insular position prevents great extremes and sudden changes of temperature, while an abundance of moisture is insured. The prevailing winds are from the southwest; consequently, they are warm, thus giving to the British Isles a much milder winter climate than that of corresponding latitudes on the other side of the Atlantic. The harbors of Labrador are blocked by ice for several months in the year, while those of the British Isles are always open.

The great economic strength and commercial development of the British Isles is largely a matter of geographical environment and of a marked adjustment to this environment by an intelligent and industrious population. Before the discovery of America these islands were on the outskirts of the field of trade, so to speak, and the share of commerce which they enjoyed was comparatively inconsiderable. The Mediterranean was the great center of commercial activity, and toward it trade gravitated. When the New World was discovered the situation changed. The oceans which hitherto had been barriers to trade and travel soon were to become the lines of least resistance to communication. The New World developed to feed the Old, and the British Isles which were practically in the center of all the land

¹ Plate III,

area of the earth became the entrepôt, or transit point of a large share of the new commerce. Again, the fact that they were in proximity to but not in contact with the continent of Europe was an additional advantage. "The English Channel enables Great Britain to remain quite independent of Europe, and yet to make full use of it; it enabled the English farmers to keep sheep in the Middle Ages, when war made sheep farming impossible on the continent, and it has preserved England from many of the terrible plagues which have devastated the neighboring countries."¹ Furthermore, the insular position has been a safeguard against successful invasion by a foreign power (§§ 193, 207).

From what has been said it is apparent that the British Isles were excellently adapted to become a powerful factor in the commercial world. As soon as the people had grown up to it, the opportunity was grasped; in more modern times vessels have been constructed to transport the commerce until the merchant fleet practically equals the combined fleets of the rest of the world. But the work has not stopped here. Strategic points at the crossroads of trade, coaling stations, lands which promised extensive future markets, or those either known or supposed to possess vast mineral wealth or other resources have been seized or otherwise acquired. Thus the lines have been laid for trade expansion. But while this was in progress the inhabitants of Britain were active in developing their abundant natural resources, and they became, at the same time, the leaders in the industrial world. This was made possible by the favorable distribution of the coal and iron deposits (§ 331) later to be described, and by the fact that the industrial revolution occurred first in England, giving that country a great start over all others. Then, when the time was ripe, a free-trade policy was adopted. Food and raw materials were allowed to come in free of duty, and manufactured goods were made at a minimum cost, enabling them to be sold at a price in the markets of the world that for a long time defied competition.

330. England's surface features. The most important geographical division of the British Isles is England, and a brief consideration of its surface features is necessary to an understanding of its economic life. In brief, there are two main natural divisions, and these afford a striking contrast to each other. The eastern and southern portions are largely a plain covered with limestone or chalk hills; while the northern and western sections are rugged, including a number of well-defined physical areas. The nature of the two contrasted surface

¹ Lyde, *Commercial Geography of the British Empire*, p. 59.

features explains, in part, the distribution of England's principal industries. The highlands of western England, running roughly from Berwick to Exeter, contained and still contain vast mineral wealth. This was utilized but little until the nineteenth century; accordingly, the western section of the country was sparsely populated until after the industrial revolution. On the other hand, eastern and southern England were adapted to agriculture and grazing; and here lived the bulk of the population, following farming and pastoral pursuits, before the great development of manufactures in the west took place.

331. Mineral resources. Of the natural resources of the British Isles, let us first examine those of the mineral kingdom. Tin, copper, lead, limestone, salt, slate, coal, and iron are found. The last two occur in abundance. Not only this, but often they are found side by side, near the sea, with plenty of limestone for flux near at hand.¹ This is a great advantage from the point of view of the manufacturer of pig iron, for such a favorable geographical distribution reduces to a minimum the cost of assembling the raw materials. Moreover, being near the sea, the cost of getting the products to the seaboard is slight. These advantages contributed greatly towards giving Great Britain first place for many decades in the world's output of iron and steel. Let us now consider briefly the principal coal and iron fields, beginning with the former.²

The *Newcastle* coal field has been worked for a longer time than any of the others, and, from an historical point of view, it has been the most important one in the United Kingdom. Recently it has been declining relatively, although it still stands second in output, the yield in 1907 being about 54,000,000 tons. The field extends along both banks of the Tyne, and the ease with which the coal can be mined and shipped is scarcely excelled in any other field in the world. About one half of the yearly output is consumed locally either for domestic purposes or for stimulating the manufactures in this region. The rest is either shipped to various English ports or is exported. It is estimated that if the present yearly output is continued for a century the field will be exhausted.

The *Yorkshire* field embraces a continuous area extending from the West Riding of Yorkshire into Derbyshire and Nottinghamshire. Its yearly output exceeds that of any of the other British fields, being

¹ The coal and iron deposits of Ireland are inextensive, besides being far apart. The Leinster and Munster coal fields are the leading ones. The former has its center at Kilkenny; the latter is situated along the lower waters of the Shannon.

² A good deal of the following account of the British coal fields was obtained from Ashley's *The Adjustment of Wages*.

about 78,000,000 tons in 1907. The yield doubled between 1860 and 1880, and increased 66 per cent from then until the end of the century. The available resources of this field are estimated to be "more than three times as great as those of the northern [Newcastle] field." The coal is used largely in connection with the manufactures of the cities located on or near the borders of the field, although some is shipped eastward by rail — mainly to Hull whence it is taken to Baltic ports or elsewhere.

The *South Wales* field in 1907 ranked third in output, about 50,000,000 tons being mined. The yield is increasing rapidly, and, in general, the coal in this region is of a superior quality, although it varies greatly in different places. For example, there are large quantities of a type which has from 80 to 90 per cent of carbon so that it is intermediary between bituminous and anthracite (cf. § 263). This is the celebrated steam coal, which produces "a greater heat at less expense for fuel and labor than any other." In some cases it is almost smokeless, which is an additional factor in its favor when used for naval and other purposes; immense quantities are sent to the British naval coaling stations. The coal deposits in the extreme southwestern part of Wales are largely anthracite, but the quantity mined each year is small, and much of it is exported. Again, in the eastern part of the fields bituminous coal predominates, while between these two extremes the intermediate type, mentioned above, is found. A geographical factor which contributes greatly towards the ease with which the coal may be marketed is the fact that deep river valleys intersect the field, and the rivers afford an easy and cheap means of sending the commodity to the sea. And where it has been found necessary to construct railways, they have been built in these valleys at a small cost. South Wales coal finds its way to all parts of the world, although a considerable quantity is retained for local smelting, etc.

The *Scottish* coal fields may be treated as a single group, since they are found comparatively close together. They also enjoy the advantages of being close to the sea. By far the largest is that in the basin of the Clyde. About five sixths of the area of this field lies in Lanarkshire, although it reaches out into several counties, extending below the port of Glasgow. Southwest of this area is the Ayrshire field extending to the ports of Troon and Ardrossan. The other chief coal-bearing regions in Scotland are in Fifeshire and Midlothian. The Scottish fields yield annually about 35,000,000 tons of coal, nearly two thirds of which comes from the basin of the Clyde. Considerable quantities are exported from Glasgow and Grangemouth, but by far

the largest amount is used in connection with the iron and ship-building industries of the Clyde.

The only other really important field is that of *Lancashire* and *Cheshire* situated to the west of the great Yorkshire field. The annual output is about 25,000,000 tons. Comparatively little of this coal is shipped either to other parts of England or abroad, but its chief market is at home for domestic and manufacturing purposes.

Of the smaller fields but little need be said. The principal ones are the "*Cumberland* or *Whitehaven* field, which supplies the blast furnaces of Workington; the *North Wales* fields in Denbighshire and Flint; the *North Staffordshire* field, which supplies the Potteries; the *South Staffordshire* field, which supplies the Black Country; the *Coalbrookdale* field, which witnessed the introduction of the modern method of smelting iron ore by coal instead of charcoal, and which has paid the penalty by its early exhaustion; the coal tracts in *Leicestershire*, and in Warwickshire about *Nuneaton*; that of the *Forest of Dean*; and that just outside *Bristol*."¹ Of these, the most important are the North and South Staffordshire fields.

Several kinds of iron ore are found in the British Isles, and the fields are in proximity to the coal beds. The best ore is the variety known as red hematite, occurring in Cumberland and North Lancashire, mainly between the two great coal fields in this region. This district stands second among the British fields in annual production, being surpassed only by that of the Cleveland region in northeastern Yorkshire. Middlesbrough has become a great center for smelting, as also Stockton, Darlington, and various places along the Tyne. Other important iron deposits are found in South Wales, the Forest of Dean, Northamptonshire, and the Scottish Lowlands. Enormous quantities of ore are imported from other countries to feed the smelting works. An excellent variety, magnetic ore, is obtained from Sweden and is smelted mainly at Middlesbrough and other neighboring places. Red hematite is brought in from Spain to various ports in South Wales and smelted at Newport, Merthyr Tydfil, and other centers.

The magnitude of the coal and iron and steel industries of the United Kingdom as compared with others is often underestimated. They engage nearly one eighth of the labor force of the country, or more than the whole of that engaged in agriculture.

Many other minerals occur, although usually in small quantities. Tin has been mined for ages in the Cornish peninsula. The copper deposits are nearly exhausted. Ores bearing both silver and lead are obtainable at Leadhills in Scotland, in the Isle of Man, Wales, etc. Limestone, oil shale, salt, sandstone, slate, and zinc occur in greater or

¹ Ashley, *The Adjustment of Wages*, p. 29.

less quantities. The total value of the mineral products of the United Kingdom in 1907 was over \$650,000,000.

332. Agriculture. The amount of land available for agriculture and pasturage in the British Isles varies greatly according to the country under consideration. In Ireland 18 per cent of the land is arable, and 55 per cent is covered with permanent pasturage; in Scotland the corresponding percentages are 18 and 7; in Wales, 19 and 40; and in England, 35 and 40.¹ The principal farm crops are cereals, grasses, and roots. In general, intensive farming is practiced and this on scientific principles. Accordingly, the yield per acre is enormous, greatly exceeding that of the farms in the United States.

The cereal crops are oats, wheat, barley, and rye. For the whole United Kingdom oats is the most important, although in England wheat predominates. Much of the wheat is the winter variety, which is sufficiently hardy to withstand the winter temperature. "Wheat-growing on an extensive scale is restricted to the southeast of England, not because the other parts of the kingdom are colder in winter, but because they are colder, wetter, and more cloudy in summer."

Formerly it was the aim of England to be self-supporting in matters of food supply; this lasted through the period of the dominance of the agricultural classes. The rise of the merchant and manufacturing interests was followed by a change of policy. The Corn Laws (which imposed an import duty on wheat) were abolished, in large part, in 1846, and under the policy of free trade England became increasingly dependent upon other countries for her food. The resulting low cost of living, since it now was made possible to secure comparatively cheap labor, enabled goods to be manufactured at a minimum cost; and it was not until near the close of the nineteenth century that other countries were able to compete successfully in the markets of the world with British manufactures. Wheat raising was particularly easy and cheap in such countries as the United States and Argentina. Besides, the development of the art of transportation made it possible to land foreign grains in English ports at a price so low that labor and capital in the United Kingdom could be employed more profitably in occupations other than farming. Even in the last twenty years the area of the cereal lands in Great Britain has been reduced by one twelfth and in Ireland by one fourth.²

¹ Herbertson, *Commercial Geography of the British Empire*, p. 22. About 3 per cent of the area of the United Kingdom is woodland (cf. § 156.)

² *Ibid.*, p. 24. From 1870 to 1900 the area under wheat decreased between 2,000,000 and 2,500,000 acres.

Potatoes and turnips are important crops, the former being of special importance in the west of Ireland. Flax is grown extensively in Ulster, and to a small degree in Scotland. In the south of England hops are an important crop, while different varieties of fruit are cultivated in the eastern part of the country. Upon the outskirts of the larger cities and towns truck farming is an important and profitable industry (cf. § 233).

333. Domestic animals. The conditions necessary for the extensive raising of domestic animals (§ 237) do not apply to the United Kingdom, with the possible reservation of Ireland. Consequently, only a fraction of the meat and dairy products required by the large population, which excels in the consumption of beef and mutton, is raised at home; hence the large imports of these goods. Such commodities can be produced at a minimum cost in comparatively new countries like Canada, the United States, Australia, and Argentina. Moreover, the development of the art of refrigeration (§ 235) and the comparatively low cost of transportation at the present day combine to make it possible to market such commodities at a profit thousands of miles from the scene of production.

The distribution of the domestic animals is governed, in a large degree, by the character of the pasture lands. Hence cattle predominate in Ireland and in western England where meadow grass grows in profusion. It is asserted that Ireland raises more live stock, in proportion to population, than any other country in Europe. Sheep are more numerous in regions where the rainfall is comparatively small, i.e. in the eastern section of Great Britain; "the chalk Downs of England and the Southern Uplands of Scotland are the best sheep regions." The mutton is of a superior quality, and excellent varieties of wool are produced. Horses, swine, and poultry are raised in considerable numbers; but it should ever be kept in mind that both agriculture and the rearing of domestic animals are far less important lines of activity and afford a livelihood to a much smaller proportion of the population than do manufacturing and commerce.

334. Fisheries. The fresh-water fisheries of the British Isles are inextensive, but those of the sea are of great value. The principal scenes of operation are the waters of the North Sea, especially over its various shallow banks, and among the islands north and west of the British Isles. Until comparatively modern times, when boats and sailing vessels monopolized the industry, it was scattered widely; but since the introduction of steam navigation there has been a tendency for the fisheries to center in a few advantageous places.

That is, there has been a better adjustment to the environment; the selected centers were likely to be as near as possible to the fishing grounds and to the best markets. There has been a tendency also for fishermen to extend their operations over longer periods of time than formerly, for their steam-propelled vessels can be moved rapidly from place to place where the best fishing offers. Thus Yarmouth vessels may go to Cornwall for pilchard, to the southwest coast of Ireland for mackerel, and to the Isle of Man or the Shetland Islands for herring.¹ The eastern part of England figures more extensively in the fisheries than any other section of the United Kingdom; of the fish landed in England, over 80 per cent in weight and about the same percentage in value are brought into ports on the east coast. Important centers are Great Grimsby, sometimes called the metropolis of the British fish trade; London, in whose Billingsgate market is collected the major portion of the combined catch of the east and south coasts; Plymouth, Yarmouth, Lowestoft, and Leith.

335. Manufactures in general. Broadly considered, the United Kingdom is the greatest and most typical manufacturing country in the world. It was not until the nineteenth century, however, when the factory system of production arose, that the manufactures assumed any great proportions. For our purposes it is not necessary to give more than passing mention to the earlier and more primitive methods of production. Under the domestic system, which preceded the factory system, goods were made in the homes of artisans who used their own tools. The raw material had come to be owned by an employer who alone was responsible for the sale of the product. Hence the laborers, who enjoyed considerable independence under the earlier gild system, were working now for another party who was more or less of a capitalist and possessed of a considerable knowledge of market conditions and of business in general. It was fortunate that such an organization had been effected before the great mechanical inventions of the latter part of the eighteenth century had been made; for independent artisans, possessed of little capital and a limited knowledge of business conditions, would scarcely have been tempted to introduce costly improvements.² Let us now consider some of the more important inventions to which reference has been made above. This will serve at the same time as an introduction to the textile industries, particularly that of cotton, which was the first to be transformed.

¹ See Lyde, *Commercial Geography of the British Empire*, p. 75.

² See Day, *A History of Commerce*, p. 213.

336. Mechanical inventions. In order to appreciate fully the significance of the inventions, it is necessary to state that two distinct sets of processes are involved in the making of cotton cloth ; and, in general, this applies to other textiles as well. First, the yarn is spun from the fiber ; then it is woven into cloth. Under the hand system of production it can readily be seen that an adjustment of the two processes of production would attend to itself automatically. The addition of a few extra weavers would call for more spinners in order that the supply and demand should equal each other. About the middle of the eighteenth century the flying shuttle was introduced, and it so greatly increased the capacity of the hand looms that the spinners could no longer satisfy the demands of the weavers. But the situation was soon to be reversed, for inventive minds were to evolve machinery the use of which would place the weavers at a disadvantage. Hitherto it had been difficult to spin cotton yarn sufficiently strong to be used for the warp of cloth, linen being required to meet this need. But in 1769 Arkwright came to the rescue with a so-called water frame, which overcame this difficulty. A year later the spinning jenny was patented by Hargreaves, and by its use one operative could produce eight threads at one time instead of a single strand as before. Once the principle had been worked out successfully, it was only a question of time before even a still greater number of threads could be made simultaneously by a single hand. In 1779 a machine combining the improvements of the two was introduced by Crompton, and this was so perfected that finer yarns from which muslins were made could be produced.

These inventions were bound, in time, to stimulate an improvement of the looms, which could no longer consume the yarns with sufficient speed. This was effected by Cartwright's power loom, which was patented in 1785, but not until after considerable delay and many changes by way of betterment did it transform the process of weaving. In fact, the handworkers struggled on in the face of the competition of the new machines for several decades before the factory system had fairly completely supplanted its predecessor. Meanwhile, water power came to be used quite commonly, taking the place of human strength as a motive power for running the machines ; and this in turn was to be superseded by steam. It was of no mean significance that Watt patented his steam engine in 1769 just as the great mechanical inventions referred to above were being made.

337. Adaptation to environment. One of the inevitable effects of the introduction of machinery was the movement of the workers from

their homes to common centers, the factories. This necessitated the selection of factory sites for the various industries. So long as water was the motive power, those districts which had a natural advantage in this respect were particularly favored; and the way in which the various industries distributed themselves, one here and another there, affords a striking illustration of adaptation to a new environment. In this connection a writer on the subject of English commerce and industry has expressed himself as follows:

"In a previous age, under the old conditions of industry, a plentiful supply of the raw material on the one hand, and easy access to the market for the sale of the finished goods on the other, were chief considerations fixing the place of manufacture. The Eastern Counties became the main seat of the woollen industry, because the flocks of sheep, from which the wool was taken, were raised and pastured on the neighbouring plains, and intercourse was easy and speedily conducted across the adjoining sea with the markets of the Netherlands and Germany. The fine breed of sheep in the West of England and the importance of the port of Bristol were jointly responsible for the fame of West of England cloth."¹

But now, with the introduction of great machines driven by water power, it became necessary to take the raw material to the most advantageous place of manufacture.

"Water was found in abundance in the Northern counties of Lancashire, Cheshire, and Yorkshire, but was scanty in the South and East. Lancashire was specially favoured. The range of hills stretching from Kendal in Westmoreland to Macclesfield in Cheshire broke the rain-clouds coming from the West; but the slope, by which the rivers reached the sea, was little more than fifty miles on the western side in Lancashire, while the Yorkshire rivers on the eastern side had to travel twice that length, and the Derbyshire rivers on the south were severed from their outlet by some two hundred miles. The water-power thus available in Lancashire was at once greater in force, and more constant in supply; and the cotton industry, enabled by comparative freedom from tradition to take advantage of the new factory system more readily than the ancient woollen industry, was established in the district. The abundant rainfall which furnished copious stores of the motive-power, caused a dampness in the air which favored the spinning of the yarn. For similar reasons the woollen industry left the Eastern Counties, and found its principal home in Yorkshire, where it had settled to some extent before and was worked on the domestic system. In this industry the parting from earlier traditions was accomplished more slowly and more reluctantly, for the traditions themselves were older and more firmly rooted. The reasons which led to the settlement of the linen industry in the North of Ireland, and in Scotland, were also similar; and the later movement of the silk manufacture from Spitalfields in London to Macclesfield in Cheshire was connected with the change from handicraft to factory."²

¹ Price, *A Short History of English Commerce and Industry*, pp. 196-197.

² *Ibid.*, pp. 197-198.

When steam came to be substituted for water as a motive power, nearness to coal (the source of the power) and to iron (the material for the machines) became prominent factors in the further readjustment to environment. But Lancashire and Yorkshire were equally as well favored for the new conditions as they had been for the old (cf. § 331). Besides, their cities and towns contained the necessary labor supply, while the numerous water ways afforded excellent avenues of transportation before the coming of the railways. Accordingly, these districts continued to be the great manufacturing centers.

338. Cotton manufactures.¹ In undertaking now a more detailed discussion of this particular branch of the textile industry, it should be stated that cotton manufacturing is the most important industry in the United Kingdom. In fact, one of the greatest branches of the world's trade, if not the greatest, is that in cotton and its products. A hundred years ago the woolen manufactures of Great Britain were worth about twenty times those of cotton; to-day the latter are double the value of the former. It was not until the nineteenth century was well under way that the cotton industry had grown to any great proportions; yet the increase in the imports of the raw material shows that great advances were being made. In 1760 the figure was 1,000,000 pounds; this grew to 56,000,000 in 1800, and to 400,000,000 in 1840. To-day the imports total over 2,387,000,000 pounds, and, deducting that which is exported, the amount retained for home consumption is 2,057,000,000 pounds (1907).²

In a single county of Lancashire, England, may be found almost one half of the cotton-spinning spindles of the world, whose product constitutes 75 per cent of the cotton goods for the world's markets. In addition to the advantages for cotton manufactures, already mentioned (§§ 331, 337), possessed by this region, the relative nearness of the port of Liverpool to the Atlantic and Gulf coasts of America, from whose ports nearly all of the raw cotton consumed in the United Kingdom originates, is an important factor. Moreover, Liverpool is one of the most important ports of communication with America, and it has come to be the chief cotton market of England and the home of the raw cotton exchange. In Lancashire the cotton industry has become highly specialized; not only are spinning and weaving carried on in different establishments, but they are conducted in

¹ For further discussion, see Whittam's "Report on England's Cotton Industry," Bureau of Manufactures, Department of Commerce and Labor, Washington, 1907, from which many of the facts here given were obtained.

² For a summary of the development of the textile industries of the United Kingdom, the reader is referred to the Appendix, Table XX.

different districts, South Lancashire monopolizing the spinning, while weaving predominates in the north and east. But specialization extends still further, for Bolton and Manchester lead in the spinning of fine yarns for spool cotton, lace, etc., and Oldham and its adjoining towns produce yarns for weaving. Again, Preston and Chorley lead in the weaving of light- to heavy-weight fancy goods; Blackburn and other neighboring towns in sheetings; while Colne and Nelson (previously called Marsden) are noted for colored fabrics. Immense fire-proof mills, built from a combination of steel, iron, brick, and concrete, are the rule; and they are so designed and the machinery is so arranged as to permit of a good distribution of light for the operatives.

In spite of the immensity of the cotton-manufacturing business at the opening of the twentieth century, the growth since that date has been rapid. In fact, "the recent erection of new cotton mills in Lancashire has been without parallel in industrial history." More than 10,000,000 spindles were added in three or four years, with a sufficient number of additional looms to consume the increased output of yarn. The increase in the number of spindles from 1900 to 1907 in the Lancashire district alone exceeded the total number of spindles in our southern states. The yearly output of the mills is enormous. In addition to supplying the home demand for a population about half as large as that of the whole United States, the yearly exports total over 6,000,000,000 yards of cotton cloth valued at over \$366,000,000, besides cotton yarn and miscellaneous cotton manufactures to the value of \$118,000,000. The only centers of production of importance outside the Lancashire district are at Paisley in Scotland, noted for its thread, and Nottingham, the region where cotton lace and net are made.

339. Woollen manufactures. This is the oldest branch of the textile industries of the United Kingdom. For a long time Norwich was the leading center of manufacture, one of its villages, Worstead, giving its name to worsted goods.¹ But later, when coal came to be an important factor in production, the Yorkshire industry grew at the expense of that of Norwich. The latter district did not have the necessary coal or even water power, both of which were abundant in the former (cf. § 331). The excellent pasturage for sheep afforded by the neighboring Pennine ranges had helped to start the woollen manufactures of Yorkshire at an early date, while towards the close of the fifteenth century they had been stimulated by the incoming of a

¹ Cf. Herbertson, *Commercial Geography of the British Isles*, p. 46.

considerable number of Flemish weavers. To-day Yorkshire is the chief center of the industry ; but, in addition to several other smaller centers, two other important ones are to be noted, namely, southern Scotland and western England.

Leeds, on the Aire, is the headquarters of the woolen-cloth trade, and Bradford is the great center for worsted goods. Farther south, in the valley of the Calder, are other manufacturing towns, in many cases famous for some specialty, notably Halifax (carpets and baizes), Huddersfield (woolen fabrics, plain and fancy), and Dewsbury (blankets). Practically all of the towns and villages on the eastern slope of the Pennines and some on the western side produce woolen goods of some sort. The valleys of the Tweed and its tributaries have several towns where cheviots and tweeds are made, notably at Galashields, Selkirk, Hawick, and Jedburgh. The west-of-England cloths are manufactured at Stroud in Gloucestershire, Bradford in Wiltshire, and at a few other less-important centers.

The home clip of wool is about 130,000,000 pounds annually, of which 30,000,000 pounds are exported. The imports retained for consumption amount to nearly 500,000,000 pounds (1907), being brought from Australasia (§§ 363, 366), South Africa (§ 385), and other countries.

340. Other textile manufactures. The superior quality of Irish linens is known the world over. The seat of the industry is in Ulster ; and Belfast, which manufactures all kinds of goods but makes a specialty of the finer qualities, is the center. Flax has been cultivated in northeastern Ireland since the time of Charles I, and the extensive production of the fiber, even down to the present day, accounts, in large part, for the location of the linen industry in Ulster. The home supply does not meet the demand, so that Russia and Belgium are drawn upon to make up the deficiency. Other linen-producing centers outside of Ireland are Dunfermline (table linen), Kirkcaldy (coarse goods), and Barnsley (upholstery linen).

The United Kingdom has never been an extensive silk-manufacturing country such as France has been, although the industry used to be of relatively greater importance than it is at the present time. Probably this may be accounted for by the fact that the cotton and woolen industries have been highly developed at the expense of others. In former times Spitalfields in London was famous for silk manufactures, but at the present day the chief centers are Macclesfield, Derby, Coventry, and Bradford (cf. § 337).

Among other textile manufactures of minor importance are those of jute and hemp at Dundee, Arbroath, and Montrose.

341. Manufactures of metals.¹ It will be recalled that the great center of the United Kingdom's most important industry — cotton manufacturing — is in the region of the Lancashire coal field ; and

¹ No detailed discussion will be given to any others than those of iron and steel.

that the extensive woolen manufactures are carried on mainly on the coal fields of Yorkshire. Similarly, the great iron and hardware industries have been developed on the Staffordshire coal fields, although, as will be seen later, other coal areas have important iron and steel industries. One striking point of contrast between the textile and metal industries is that the raw material for the latter is largely produced at home, while for the former, as has been seen, it is imported extensively.

The city of Birmingham and others on or near the South Staffordshire coal fields have long been famous for their iron and hardware manufactures. Birmingham has been called the metropolis of the English iron and metal trades. These started centuries ago when the wood of the neighboring forests was still used to smelt the iron. The manufacture of iron and steel goods in some form or other extends for miles through the region stretching from Birmingham mainly in the direction of Wolverhampton. All kinds of metal goods are produced here from pins and pens to machinery and steam engines.

Sheffield is the center of the iron industries of the Yorkshire coal fields. Its special line, and one which has made it famous, is the manufacture of cutlery and tools. For the best goods Swedish iron is imported; otherwise the local product is used. Other important manufactures of this district are steel rails, armor plate, scientific instruments, and all kinds of machinery.

In the northeastern counties, in the vicinity of the Newcastle coal field and its neighboring Cleveland iron region, shipbuilding, gun making, and the production of materials for railway plants are the leading metal industries. The shipbuilding yards on the Tyne, Tees, and Wear rival those of the Clyde. The machinery for the great textile industries is made chiefly in the neighborhood where it is used, since, as a rule, coal and iron abound where these works are situated. Manchester, Oldham, and Rochdale are producing centers for cotton-manufacturing machinery; Bradford and Keighley for a large proportion of that which is required by the woolen plants. In the region of the Scottish coal fields there are numerous iron and steel manufactures, particularly shipbuilding at various places on the Clyde, and machinery and locomotives at Glasgow.

342. Other manufactures. The United Kingdom has developed an extensive chemical industry. The great industrial development of the present day calls for a widespread use of chemicals; it is almost impossible to overestimate their importance in extracting certain ores, in electrical works, in the manufacture of by-products, and in the making of glass, soap, paper, etc. Large alkali works are

found at various places in the valleys of the Mersey, Tyne, and Dee. Glass making is important at Newcastle, St. Helens in Lancashire, and Glasgow; soap in Glasgow; candles and paraffin at various places in Midlothian.

Since the making of earthenware and porcelain requires a great deal of fuel, the best environment for their manufacture is on or near coal areas; if clays occur near by, so much the better. These conditions are found in the district called "the Potteries" in North Staffordshire, where earthenware goods in great variety are made at such centers as Burslem, Stoke, Hanley, and Etruria. Worcester and Derby are famous for their porcelain.

Among other important manufactures are leather working, sugar refining, jam and jelly making, beer brewing, and the distilling of whiskies.

343. Internal transportation in general. The internal transportation facilities of the United Kingdom consist of roads, rivers, canals, and railroads. Though faulty in some particulars, their development has been so perfected that the carrying of persons and property from one part of the country to another is easy and rapid. It may be well to mention here that the great extent of coast line possessed by Great Britain, and the general configuration of the country are important factors affecting the question under consideration. The tidal coast line is 3000 miles long, being greater than that of any country in continental Europe; no place in Great Britain is far from the sea. Consequently, enormous quantities of goods are sent coastwise from port to port at a rate so low as to defy the competition of any route that is strictly internal.

344. Roads. All of the well-settled parts of the country are traversed by roads which, in the main, are good. This is particularly true of the trunk lines of travel of which England alone has upwards of 22,000 miles. As a rule, the roads are very steep in hilly districts, thus contrasting unfavorably with French roads which were built so as to avoid steep inclines. The Romans, the great road builders of antiquity, during their occupation of Britain supplied the country with an excellent system of roads, but these seem to have been used but little by the great mass of the people. There were several main lines leading from London to the remote parts of the country. After the departure of the Romans the roads fell into decay, so that, in many cases, it is difficult to determine their original location. Then followed a period before the introduction of turnpike roads, when the rivers were the principal means of transport. At the present day the roads are used not so much for long-distance traffic as for carrying produce from farms to railway stations, or from the latter to neighboring points of consumption. It is almost impossible to overestimate their importance for such purposes as well as for travel.

345. Rivers and canals.¹ There are about 4770 miles of inland water ways in the United Kingdom, 3800 miles of which are in England and Wales; over 600 in Ireland; and the rest (nearly 350 miles) in Scotland. The numerous, short navigable rivers afford the basis of this system, and these have either been canalized or united by canals, of which a regular network is found in some sections of the country. Of these more will be said later. The Thames is both the most important and the largest river in England, being navigable for 145 miles. Other rivers having the greatest extent of navigation are the Severn, Shannon, and Forth. But some of the shorter ones, such as the Tyne, Wear, Tees, Humber, Clyde, Mersey, and Ribble, are of great importance for commercial purposes.

Immense sums of money have been expended in improving the navigation of the rivers, dredging their lower courses so that ports could be located some distance inland, and in building canals. Efforts in these directions commenced in the seventeenth century, or even before that time, but the "canal era" came later; most of the canals were built between 1760 and 1830 (cf. § 296). As in the United States, it was before the introduction of railways that these were of great significance in the economic development of the country; with the railways came a serious decline in the traffic on the canals. This has been attributed to the fact that the railways had acquired control over most of the canals, and that they regulated their traffic as they wished; but recent investigations have tended to show that this claim has been considerably exaggerated. It is clear that any explanation of the phenomenon is faulty which fails to take into consideration the fact that the physical condition of most of the canals has remained unchanged since the time of their construction; accordingly, they could not fail to become antiquated. This fact has caused considerable attention to be directed to the question of modernizing the water ways, and there are evidences that the movement will bear fruit; to it, in fact, the building of the Manchester ship canal may be attributed, at least in part. This water way is, by far, the most important of the British canals, viewed from the standpoint of either the engineer or the business man. It is 35.5 miles long and runs from Eastham to Manchester; it was commenced in 1887 and was opened for traffic on January 1, 1894. Its original depth, 26 feet, was considered insufficient; accordingly, after three years' continuous work, involving a heavy expenditure

¹ See article by U. A. Forbes in American Waterways, in *The Annals of the American Academy of Political and Social Science*, Vol. XXXI, No. 1, January, 1908, from which some of the facts in this section have been derived.

of money, a uniform depth of 28 feet has been provided, so that now freight steamers of almost any size can go to the docks at Manchester.

In general, canal building in the United Kingdom, particularly in England, has not been difficult. There were no such physical obstacles as confronted the engineers during the canal era in the United States (cf. § 296), nor were the centers to be connected as far distant as they were in this country. Even the Pennines offered so slight a barrier to communication that three canals have been constructed across them, connecting the ports of Goole and Hull on the east with those of Liverpool and Preston on the west. Other important canals connect the Severn with the Thames, and the Thames with the Trent. In Scotland the two principal canals are those connecting the Forth near Grangemouth with the Clyde near Renfrew, and the Caledonian canal through Glenmore.

346. Railroads. Already it has been seen that England was the pioneer in railroad building, and that this method of transportation passed through numerous preliminary and experimental stages in the Old World before its introduction into the United States (§§ 298, 299). No attempt will be made here to describe in detail the network of railroads in the United Kingdom, but it may be said that as carriers of commerce it is almost impossible to overestimate their importance. They have contributed more than any other single factor towards the development of the internal commerce of the country, and they continue to be the chief means of internal transportation. There are over 23,000 miles of railway, of which nearly 16,000 miles are in England and Wales; the rest of the mileage is pretty evenly divided between Scotland and Ireland. All but upwards of 3000 miles is standard gauge. London is the great railway center, and important lines radiate from that city in all directions, terminating in great industrial centers or at important seaports.

Some of the principal lines are the Great Western, connecting London with Birkenhead; the London and Southwestern, running from London to Devonport, with branches to Southampton, Portsmouth, and Weymouth; the London, Brighton, and South Coast, affording connections with Portsmouth and Newhaven; the Southeastern and Chatham, running through Tunbridge, Ashford, and Folkestone to Dover; the Great Northern, the Northeastern, and the London and North-western, which, in conjunction, connect London with the Midlands and the north of England. The points of connection between the main English lines and those of Scotland are Carlisle and Berwick. The Scottish lines radiate from Glasgow and Edinburgh; those of Ireland from Dublin.

347. Merchant marine. The United Kingdom occupies the first place among the countries of the world in the size of its merchant

marine, and the growth since the advent of the steamer has been enormous. It was not until the third decade of the nineteenth century that the first steamer crossed the Atlantic. The formation of the Cunard Company soon took place (1839), and at that time the total tonnage of merchant vessels on the British register was 3,312,000, comprising 28,138 sailing vessels and 824 steamers, — 28,962 in all. In 1908 the tonnage of the merchant marine of the United Kingdom was 17,318,351, or close on to 50 per cent of the world's tonnage. Sailing vessels numbered 1137; steamers, 8405, — a total of 9542.¹ The figures for 1908 take into consideration only vessels of over 100 tons; but, making due allowances for those under that figure, it is clear that the number of vessels in the British merchant marine has decreased materially during the past 70 years. Sweeping changes have taken place in shipbuilding during the period under consideration; steamers are supplanting sailing vessels; steel and iron have, as the material for construction, taken the place of wood to a large degree; and the growth in size, as the above figures suggest, and the increase in speed have been enormous.

We have seen that the navigation laws of the United States restrict the coasting and intercolonial trade to vessels flying the American flag (§§ 313, 314). Similar regulations used to exist in the British Isles; but, by the repeal of the Navigation Acts in 1849, the coasting trade was thrown open to all comers, and the policy of "free ships" was adopted (cf. § 311).

Half a century ago the British merchant marine carried only about 50 per cent of the foreign commerce of the United Kingdom, but as the tonnage has increased, so has the percentage of the foreign trade that is carried under the British flag, until now probably the latter is not far from 75 per cent. Besides, Great Britain is the great commerce carrier of other nations; British vessels carry a large proportion of the enormous commerce which passes to and fro between the United Kingdom and the United States; they carry approximately 50 per cent of the foreign trade of Russia, Holland, Belgium, France, and Portugal, and a smaller share of that of many other countries.

348. Foreign commerce. In studying the foreign commerce of the United Kingdom it should ever be kept in mind that this country differs from many others in that it carries on a large entrepôt business. "It trades not merely in its own surplus produce — raw

¹ In the same year the tonnage of the merchant marine of the colonies of Great Britain was 1,391,186. Steamers numbered 1275; sailing vessels, 746. The total merchant marine under the British flag was 18,709,537 tons.

and manufactured—but in almost every article of colonial and foreign produce, raw and manufactured, in which a profitable trade can be done.” A partial explanation of this phenomenon is that the commerce between various countries is too small to make a direct exchange of commodities advisable. It is cheaper to send the goods to some center such as London, whence they are reshipped to their various destinations.

The foreign commerce of the United Kingdom is larger than that of any other country in the world. In 1907 it amounted to over \$5,217,000,000.¹ The leading causes for the preëminence of the British Isles in this particular already have been mentioned (§ 329); but within recent years other countries, notably the United States and Germany, have been developing their foreign trade faster than has the United Kingdom, until they have become dangerous rivals in the struggle for commercial supremacy. The real situation, which caused considerable anxiety to British statesmen and business men at the beginning of the twentieth century, was that the country's export trade, in particular, was not in a healthy condition. This led to extreme pessimism on the part of certain reformers and others who were confident that their country was entering upon the initial stages of decay. It was proposed, among other remedies, to change completely the commercial policy of the country and to return to protection. There is a danger of England losing the coveted position of leader in the industrial and commercial world, but there are no indications whatever that she is declining absolutely in any important particular.

A noticeable feature of the foreign commerce is the great excess of imports over exports each year. In 1907 the former amounted to \$3,143,000,000; the latter to \$2,074,000,000,—an excess of over \$1,000,000,000. During the fifteen years from 1890 to 1904, inclusive, the excess of the imports over the exports was \$11,010,000,000. Such a condition of affairs needs some explanation; for it might well be wondered how a country could continue, year after year, to import so much more than she exports without becoming bankrupt. In the case of the United Kingdom this is made possible by the fact that vast sums of money from abroad are payable each year to her citizens, and these payments, in many cases, are made in kind (commodities) rather than in cash. Loans bearing a steady rate of interest have been made to many companies and to various governments in foreign countries to enable them to build railways, open mines, and otherwise

¹ Of the foreign commerce of the United Kingdom, in 1905, England had 90.5 per cent; Scotland, 8 per cent; and Ireland, 1.5 per cent.

exploit their natural resources. British vessels earn enormous sums of money in carrying goods for other countries.¹ Commissions and premiums of various kinds are payable in London, the commercial and financial center of the world. When these and other similar items are taken into consideration, the "unfavorable balance of trade" is accounted for.

With reference to the exports it should be noted that manufactured goods form, in value, about 75 per cent of the whole, and this figure becomes considerably greater if we include the partly manufactured commodities; but a small percentage is thus left for other classes of exports such as foods and raw materials. The latter are nearly all imported first, and form a part of the large entrepôt trade mentioned above. There is one noticeable exception, and that is coal. In 1903 about 45,000,000 tons were exported, being between 15 and 20 per cent of the total output of the British mines. Cotton yarns and the various classes of cotton goods make up over 25 per cent of the exports, and woolen yarns and woollens about 10 per cent.

Of the imports, "food, drink, and tobacco" constitute the principal class, amounting, in 1907, to \$1,204,000,000. The largest item is grain and flour (\$366,940,000), although meat and meat animals amount to over \$252,000,000. "Raw materials" are not far behind the first group, for the annual value of their imports is \$1,176,000,000; by far the largest item here is cotton (\$344,589,000), and wool stands second (\$177,431,000). The imports of manufactured goods amounted to \$752,000,000 in 1907. Although the United Kingdom is generally spoken of as a free-trade country, this is not literally true, for there are a small number of duties levied on such imports as tobacco, tea, coffee, cacao, wine, beer, and spirits.

A detailed consideration of the geographical distribution of British foreign trade would show that it is world-wide. Almost every country is drawn upon, to a greater or less extent, for goods which figure in the imports, while British manufactures find their way to the remotest parts of the world. Rather more than a quarter of the foreign trade is with British possessions; one quarter of the imports come from them, and they take about one third of the exports. The commerce with Europe is far more extensive than with any other continent; France and Germany, in order, lead in furnishing imports, while the

¹ In a special report presented to the British Parliament in 1903 by the British Board of Trade regarding the commerce of the United Kingdom, it was estimated that a sum not less than £90,000,000 should be added to the exports on account of the ocean-carrying trade.

same two countries, in reverse order, are the largest European purchasers. The single country with which the United Kingdom has the largest trade is the United States, but the purchases from the latter, which amount to nearly a quarter of the value of all the imports, are between four and five times as great in value as are the exports sent to that country. The enormous value of the imports from the United States is due to the prevalence of such important items as cotton and other raw materials, and foodstuffs.

CHAPTER XXIII

THE DOMINION OF CANADA

349. Introductory. British America includes the Dominion of Canada, Newfoundland, British Honduras, British Guiana, the Bermudas, the British West Indies, and the Falkland Islands. Of all the British possessions the world over, Canada is the largest, the most important, the most prosperous, and the colony whose immediate future seems the brightest. Its area is practically the same as that of the United States, and, to add another comparison, it embraces about one third of the whole Empire. It includes all the continent north of the United States with the exception of Alaska and the coast of Labrador; the latter belongs to Newfoundland. The country is as yet sparsely populated excepting over limited areas; but, according to recent investigations, it has been found that cereals and other hardy crops can be raised easily far north of the present cultivated areas — in regions hitherto considered unsuited to agriculture by reason of the rigorous climate. Here also are being found vast stores of mineral wealth, although much of the country has not been “prospected.” The realization is just dawning that there are great possibilities in the settlement and development of Canada northward as well as westward as soon as the country is made accessible by the building of railways; and in this work the Canadians are now putting forth the most strenuous efforts, as we shall presently see.

The Dominion of Canada as a political unit has been in existence for a little more than forty years. On July 1, 1867, it was formed by the confederation of a number of separate provinces. Other provinces have been admitted since, so that there are now nine — Nova Scotia, New Brunswick, Prince Edward Island, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, and British Columbia. In addition, there is a vast region commonly called the Northwest Territories, from which it is likely that other provinces will be formed as the country becomes more densely settled. Ottawa, in Ontario, is the seat of the federal government; the various provinces have their own parliaments which deal with affairs of local concern.

350. Surface features. It is difficult to present, within a limited space, and with any degree of accuracy and detail, the surface features of so extensive a country as Canada. This information can best be obtained by consulting a physical map. Broadly speaking, however, there are several natural divisions that may be mentioned as having an important bearing upon human activities. In the extreme west are high ranges of mountains of which the easternmost are the Rockies (cf. § 66). These are a great climatic barrier in that they shut off the moisture from the Pacific. They are not without great direct economic significance, however, for they are storehouses of mineral wealth; the flood plains of the rivers (Fraser, Upper Columbia, etc.) are fertile agricultural lands; and their extensive forests are of great value. Their bearing upon transportation, especially in the matter of making railway building difficult, has been far-reaching. Descending gradually from the eastern slopes of the Rocky Mountains, the next great surface feature encountered is what we may designate the Great Central Plain, which has a slight slope from near the boundary line between Canada and the United States to the Arctic Ocean. This region embraces a large proportion of the whole area of Canada. The southwestern portion, in particular, consists of prairies whose soil and climate are excellently adapted to agriculture. Here "there is a rise on the whole from east to west, and this rise takes place in such a manner as to form what are known as the three prairie steps. The lowest level in this region is that of the Red River Valley [a portion of Manitoba], between 700 and 800 feet. West of that valley the surface rises to about 1500 feet, and this terrace stretches westwards for about 250 miles. The ground then rises to about 2000 feet, and then the rise is more gradual to the foothills of the Rocky Mountains."¹ North and east of the prairies are extensive forests, which reach from the frontier of Alaska and, bordering upon those of the Cordilleras, stretch across the country from northwest to southeast. The more densely wooded southern part of this area gradually passes into a more sparsely forested region farther north, beyond which are tundras such as are found in northern Europe and Asia. In the eastern part of Canada are extensive stretches of uplands. The Appalachian Mountain system, already described (§ 63), extends through New Brunswick to the neighborhood of the mouth of the St. Lawrence.

351. Agriculture. The most widespread occupation in Canada is farming, which is carried on to a greater or less extent in all the

¹ Chisholm, *Handbook of Commercial Geography*, p. 458.

provinces. The soil and climatic conditions are suited to the growing of all the fruits and vegetables of the temperate zone. Mixed farming prevails in the east, and before the opening up of the cereal lands of central Canada, wheat and other cereals were produced for local consumption. But the eastern farmers can no longer compete in the growing of cereals with those farther west, so that the latter supply the former with most of their flour and feed. Canadian dairy products, particularly cheese, are in great demand in the mother country, but the quantity exported has decreased in recent years, owing to a greater home consumption. The valleys of the Annapolis and Cornwallis rivers, often called the "Garden of Nova Scotia," are famous apple-growing regions, and the surplus product is sent chiefly to the English market. Southern Ontario, the peninsula nearly surrounded by the Great Lakes, is also a fruit region. It is in the same latitude as northern Italy, and produces the choicest apples, pears, plums, peaches, grapes, and other small fruits. The less perishable of these are sent to the English market, but specially equipped trains convey large quantities to more or less distant local centers.

The development of Canada, particularly the west, is proceeding at such a rapid pace that any statement regarding the output of the farms, or mines, or forests must soon be antedated. According to a report published by the Census and Statistics Office, the area of field crops in 1908 totaled over 27,500,000 acres, and their value was estimated to be \$432,534,000. The crop of greatest value was hay and clover (\$122,000,000); the yield of oats is about double that of wheat, which latter has now passed the 100,000,000-bushel mark,¹ an increase of 100 per cent since the opening of the century. The extension of railways in western Canada and the occupation of the fertile lands in the wheat belt by immigrants account, in a large degree, for this increase. As late as 1901 Ontario produced one half of all the wheat grown in Canada, but, according to the official estimates for 1908, the center of production had so shifted that the Northwest provinces were credited with a crop valued at over \$72,000,000 as compared with less than \$19,000,000 for the rest of the Dominion. The dangers of frosts occurring before harvest time are being minimized by the selection of hardy varieties of the cereal for seed, which, fortunately, yield hard wheat of excellent quality. Broadly considered, the soil in large areas of central Canada is a rich black loam with a subsoil of clay which retains considerable moisture. "The richness of the soil,

¹ The wheat yields in 1906, 1907, and 1908 respectively were 136,000,000, 91,333,000, and 112,434,000 (estimated) bushels.

as also its color, is due to the accumulation through centuries of the droppings of birds and beasts, and the ashes of prairie fires." In the more arid regions hundreds of thousands of acres of land are being made productive by irrigation. •

The more optimistic of those best informed regarding Canada's agricultural resources predict that within a decade she will produce sufficient wheat to feed the teeming population of the British Isles. A more conservative authority, however, who based his conclusions upon an exhaustive investigation made as the basis for a report to the British Board of Trade, stated that "very great improvements in the productive powers of the country, and a very considerable increase in the effective population, as well as a more exclusive regard to wheat cultivation, would have to take place before the northwest could be regarded as being in a position to be relied upon as producing for export to Great Britain a quantity of wheat nearly sufficient for the growing requirements of the country." •

352. Forest resources. The extent of timbered area in Canada is exceeded only by that of Russia and the United States. The reckless waste and extravagance which, until recent years, characterized the exploitation of the forest resources in the United States, and the evil results and unrest which have followed, promise to stand as a healthful warning to Canada, where the danger of a forest famine is not as yet imminent. According to an estimate of the Superintendent of Forestry in 1903, there were 192,000,000,000 feet of merchantable timber; other estimates show that there are about 1,250,000 square miles of forest lands, an area between one third and one half of the whole extent of the country. It has been pointed out, however, that the lands possessing forest growths, which are both commercially valuable and also accessible for exploitation upon the present stage of transportation development, are extremely limited. The wealth of the great northern forests is as yet largely a matter of conjecture, but it is believed to be great; at all events it cannot be utilized until railroads are extended thither. Commercial woods are found in great variety; these include various kinds of pine, spruce, fir, cedar, oak, elm, beech, and maple. The cost of cutting and transporting the logs is comparatively small, for labor is cheap in winter and the abundant snow packs easily into excellent temporary roads over which the logs are traileed to the banks of the rivers. Then in spring they are "driven" down the swollen streams to the sawmills. The workmen, who no longer are needed in the woods, find employment as extra farm hands during the summer months. Important centers of the lumber trade are Ottawa, Deseronto, and St. John.

Pulp wood is an important product, large quantities of which are exported to the United States. The principal woods used for pulp are spruce, hemlock, and poplar, of which Canada has an abundant supply; in particular, she possesses the only important spruce forests that remain in North America.

353. Minerals. Canada is known to have great mineral wealth, although it has been as yet but slightly developed. As the country has become better known and more carefully prospected, new mines have been discovered, and it is confidently believed that it is only a matter of time before Canada will occupy a conspicuous place among the nations in the production of a great variety of precious and useful minerals. From 1886 to 1907 the value of the total output increased from \$10,221,000 to \$86,843,000; the latter was a record figure, being 10 per cent greater than that of the previous year.

The annual value of the coal output exceeds that of any other mineral, being \$24,382,000, or nearly 30 per cent of the value of the total product. This mineral is found on both the Atlantic and Pacific coasts; there are, besides, important deposits elsewhere, especially in Alberta and southeastern Saskatchewan.¹

The extensive coal fields of Nova Scotia, both in the peninsula and on the island of Cape Breton, have excellent iron ore within easy distance; and, stimulated by the government bounties (cf. § 366) offered, important iron and steel works have been started at Sydney, Cape Breton (The Dominion Iron and Steel Company), and at other points in Nova Scotia and Ontario. The iron ore for the Sydney plant is obtained from extensive deposits in proximity to tide water in Newfoundland. The production of pig iron and steel is, as yet, comparatively small, but it is increasing rapidly. For the year ending March 31, 1908, the Dominion government paid to the various firms engaged in iron and steel production bounties amounting to \$2,303,140, such payments being designed to assist in establishing manufacturing plants in Canada and to help them during the "infant industry" stage. Other bounties are given on the production of lead, crude petroleum, and binder twine, amounting in all to \$484,218 in 1908.

¹ In 1907 the output by provinces, in short tons, was as follows:

Nova Scotia	6,354,133
British Columbia	2,364,898
Alberta	1,591,579
Saskatchewan	151,232
New Brunswick	34,584
Yukon	15,000
Total	10,511,426

The minerals coming next to coal in value of output in 1907 were copper, \$11,307,000; nickel, \$9,535,000; gold, \$8,383,000; and silver, \$8,349,000. The nickel supply of the world is confined largely to Canada and New Caledonia, the latter being a French penal colony in the South Pacific east of Australia. The nickel district is around Sudbury, in Ontario, and the annual output constitutes a large percentage of the world's product. The yield of gold has decreased steadily since 1900, owing to the constantly diminishing output of the Yukon, which was \$22,275,000 in 1900 and only \$3,150,000 in 1907; it is stated officially that this famous gold district will continue to be a small producer until improvements are effected in treating low-pay gravels. Canada's silver output has been increasing rapidly, especially since the opening of the famous Cobalt district in northern Ontario in 1904. The yield for 1908 exceeded in quantity that of the previous year by over 70 per cent. If the present rate of increase continues, Canada will shortly become one of the chief silver-producing countries in the world.

354. Fisheries and furs. The fisheries, especially those of the Atlantic coast, are among the largest in the world, and give employment to nearly 80,000 men. The catch includes a great number of varieties, differing according to the region where the fish are taken. The annual value of the fisheries is over \$26,000,000, those of Nova Scotia comprising one third of the whole amount. Cod, herring, lobsters, and mackerel are the principal varieties in the catch of that province. New Brunswick is noted for its herring fisheries and stands third in value of output; the second place is taken by British Columbia, whose salmon fisheries are renowned. There are numerous canneries, especially in the Maritime Provinces and British Columbia; about one half of the total catch is exported either frozen, canned, or preserved in some form, while the rest is distributed among local markets throughout the Dominion.

Some of the best and most valuable furs are obtained from Canada, which continues to be one of the greatest fur-producing areas in the world. Although the fur trade has been vigorously prosecuted in northern Canada for two centuries or more, it is still in a prosperous condition; certain animals, however, notably the beaver, otter, and silver fox, are becoming rare. The value of the annual export of furs, most of which are undressed, is about \$2,500,000.

355. Manufactures. From what already has been said it might be expected that Canada's principal products would be foods and raw materials; and this is the case. Yet a great deal has been

accomplished in the development of manufactures, towards which end American capital has played a large part. A protective tariff considerably lower than that of the United States has not been without influence upon many industries. The value of the output of the manufacturing plants has nearly doubled since the opening of the century. The most important lines of activity are those connected with the elaboration of foodstuffs, the lumbering business, textiles, metals, and leather. Naturally the principal manufactures are located in the most populous parts of the country, rather than in the newly settled west; they are found mainly in southern Ontario and Quebec.

356. Inland water ways. Canada possesses an excellent system of inland water ways, the central feature of which is the great commercial highway formed by the St. Lawrence River and the Great Lakes (§ 307). This extends over 2200 miles inland, affording uninterrupted means of water communication, for vessels drawing 14 feet of water or less, from the Strait of Belle Isle to Port Arthur. Shipments are usually made, however, in boats specially constructed for the lake traffic, as far as the Welland Canal, where the cargoes are transferred to canal boats which meet ocean steamers at Montreal. It is not to be understood that this water way has always been in its present good condition. Nature placed many obstacles in the path of the navigator of this route, and these have been overcome only after the expenditure of millions of dollars. But this conquest of nature is, in a way, only partial; for during the winter months, usually from the end of November to the end of April, the St. Lawrence is icebound and traffic is forced into other channels. This fact has a very important bearing upon the railway problem presently to be discussed (§ 357).

Let us now examine briefly some of the improvements which have been effected in Canada's great natural water way. Passing over such matters as the placing of numerous buoys and lights, it should be noted that to place Montreal at the head of ocean navigation was no small task; the St. Lawrence was extremely shallow at several points between Quebec and Montreal, so that vessels drawing more than 10 or 12 feet of water were unable to reach Montreal during a large part of the season of navigation. As early as 1826 the idea of deepening the channel was proposed; but dredging operations did not begin until 18 years later, and they were soon abandoned. In 1851 the deepening of the present channel was commenced; by 1882 a depth of 25 feet was reached, which has been increased to about 30 feet at the present day. It has been proposed to continue the work

of dredging until the minimum depth between Montreal and the sea is 40 feet. The width of the channel is in no place less than 300 feet, and at points of curvature it broadens to 550 feet. Strenuous efforts are being made to make Montreal a first-class port in every particular. Over \$10,000,000 have been expended, and improvements are in progress involving the outlay of \$4,500,000 more. The ocean-bound traffic passing through Montreal is increasing rapidly;¹ and this is due not only to the expansion of the west, but also to the diversion of a considerable amount of produce, chiefly wheat, from other routes to tide water.

But the work which has been done between Quebec and Montreal is only a small part of all that was required to perfect the navigation of the St. Lawrence and the Great Lakes. Canals have been constructed between Montreal and Lake Superior, aggregating 73 miles in length, at a cost of about \$70,000,000.¹ These are the Lachine, Soulanges, Cornwall, Farran's Point, Rapide Plat, Galops, Murray, Welland, and Sault Ste. Marie ("Soo"). A boat in passing from Montreal to the head of Lake Superior would have to go through 48 locks, and the elevation thus effected would be 551 feet.

It should be noted in passing that several projects are being considered, which, if carried out, will be of great significance in the future development of the country. Of these perhaps the most important is the building of the Georgian Bay Canal; the purpose of this work is to shorten the present water route between Lake Huron and Montreal by upwards of 300 miles, through the construction of a ship canal with a depth of 20 feet or more from Georgian Bay to Montreal via the French and Ottawa rivers. The distance would be something over 400 miles, but so many natural water ways exist along the route that the aggregate length of canals to be constructed would not be more than 40 miles. The Dominion government has spent already more than \$500,000 in surveys; the estimated cost of the work is approximately \$100,000,000. If constructed, this canal in all likelihood will attract to Montreal, excepting in the winter months, considerable traffic which would otherwise find an outlet through American ports.

357. Railways. Strenuous efforts also have been put forth by the Canadians in building railways. The water ways can be used for only

¹ In 1907 Montreal shipped 25 per cent more grain and flour abroad than in 1906, although the latter was a record year.

¹ The cost to Canada of the construction and enlargement of all canals to 1908 was \$93,442,874.

about seven months in the year, and this makes railways necessary, especially in the regions where the water ways serve the main purpose of transportation when they are not closed by ice. Besides, the people of Canada wish to have their own outlet for trade during the winter months rather than have their traffic diverted to American ports on the Atlantic; and since the harbors of both Halifax and St. John are open the year round, this can be accomplished, it is believed, by providing adequate railway accommodation to these ports. Again, the potential agricultural, mineral, and forest wealth of the west cannot be exploited until the country is opened up by railways. In the effort to solve these and other transportation problems, either of local or national importance, nearly 23,000 miles of railway had been built and were in operation by June 30, 1908, and over 750 miles of additional lines were opened for traffic soon after that date. At the same time, 4327 miles of new road were reported as actually being under construction, while several lines were being projected. It seems as though Canada were just entering upon an era of great expansion in railway building, although, at the present time, there is scarcely a country in the world which has as great a railway mileage in proportion to population. Several lines have been built for the purpose of opening up new lands for settlement and providing an outlet for future production. Thousands of immigrants are being attracted to Canada and are taking up lands in the west and in the older provinces, and, to all appearances, the movement has just begun. In the year 1907, 277,376 new settlers arrived — over 60,000 more than in the previous year. A noticeable feature concerning Canadian immigrants is that a large proportion come from the British Isles and the United States; and because they have customs, institutions, and a language similar to the people of the Dominion, they are easily assimilated. The rigorous climate of Canada is a disadvantage in many particulars, but it seems to exercise a healthful influence in keeping away the less desirable peoples of southern Europe and attracting the more hardy northern stock.

Excepting a few lines totaling less than 2000 miles, the railways are owned by private companies. Of these, the Canadian Pacific, the Grand Trunk, and the Canadian Northern embrace a large proportion of the mileage. The former spans the continent from ocean to ocean and has a number of steamships in service on the Atlantic, Pacific, and the inland water ways as well. The Canadian Northern system is expanding rapidly and promises to be eventually a transcontinental line. Of the railways under construction the Grand

Trunk Pacific, as it is commonly called, is the most extensive ; it is to be a transcontinental line, wholly within Canadian territory, covering a distance of about 3600 miles from Moncton, New Brunswick, to Prince Rupert, British Columbia, near the southern boundary of Alaska. Several branch lines of considerable length and importance are to be constructed. This railway will open up a great deal of new country which is known to be rich in minerals and forests, while its prairie section leads through lands excellently adapted to the growing of wheat. A considerable traffic seems assured to the railway as soon as the country through which it passes becomes populated. From Moncton it takes as direct a route through Canadian territory as is practicable to Quebec, crossing the St. Lawrence River about 5 miles above the city of Quebec. It then proceeds directly westward to Winnipeg, passing in the vicinity but north of lakes Abitibi and Nipigon, thus opening up large areas which are as yet unsettled. This division, which is about 1800 miles in length, is being constructed by the Canadian government ; when completed it will be leased at a rental based on the cost of construction, for a period of fifty years, to the Grand Trunk Pacific Railway Company, which is building the divisions between Winnipeg and Prince Rupert. The line will cross the Rocky Mountains via the Yellowhead Pass. But one summit is encountered, and the figure showing the maximum gradient is smaller than that of the other transcontinental lines. It is expected that the road will be opened for through traffic in 1911.

With the development of the grain-growing areas and the general expansion of industries, new transportation problems arise ; even with the present output of agricultural crops there have been blockades of traffic, and it is felt that the Grand Trunk Pacific, when completed, will not solve the difficulty. Hence a project has arisen to build a railroad to Fort Churchill on Hudson Bay. A glance at the map will show that the shortest route from Canada's grain belt to the great market in England is via Hudson Bay ; but the latter is open to navigation for only about three and one-half months in the year, and for but two months — September and October — after the shipments of the year's crops commence. It is believed that for a long time to come the road could not be made a financial success. The Canadian Northern has already built a railway from Winnipeg in the direction of Hudson Bay as far as Le Pas on the Saskatchewan River. From there to Fort Churchill the distance is about 480 miles, and the character of the country is such that it " cannot at present, nor will it for years to come, be able to support a railway by its own

resources." Such a railway if built must depend for traffic largely on the grain and other produce it might carry from the prairies to Fort Churchill.

358. Foreign commerce. For the fiscal year ending March 31, 1908, the foreign commerce of Canada aggregated \$650,793,131, which was considerably greater than that of the previous years. The imports continue to be greater than the exports, but there is in this no cause for alarm. Agricultural products form about one quarter of the value of the exports, the next largest groups in order being live animals and animal food products, and lumber and timber. Manufactures form less than 12 per cent of the total value of the exports. The bulk of the imports are manufactured goods, although commodities of tropical and subtropical origin, such as sugar, tea, coffee, and cotton, are brought in in large quantities.

A noticeable feature of Canada's foreign trade is that about nine tenths of it is with the United Kingdom and the United States; this figure has not varied to any great extent since Confederation (1867). The trade between Canada and these two countries, however, varies greatly; nearly 60 per cent of the imports come from the United States as compared with only about 25 per cent from the United Kingdom, and this in spite of a preferential tariff in favor of the latter. Of the exports, however, between 50 and 55 per cent are taken by the United Kingdom, and something more than 35 per cent by the United States. Since 1897 the Dominion government has granted a preferential tariff to the mother country and to a large part of the Empire; but in spite of the preference, which now averages about 30 per cent, the United Kingdom has made little headway during the last eleven years in marketing her goods in Canada in competition with the United States.

CHAPTER XXIV

AUSTRALASIA

The British possessions in Australasia include the commonwealth of Australia with its dependency, British New Guinea; the dominion of New Zealand and its adjacent islands; and the crown colony of Fiji. In accordance with our general plan of giving attention only to the more important parts of the Empire, the present discussion will be confined to Australia and New Zealand.

THE COMMONWEALTH OF AUSTRALIA

359. Introductory. Until recently Australia consisted of five British colonies, New South Wales, Victoria, Queensland, South and West Australia; but on January 1, 1901, they, together with the island of Tasmania, were federated into a single commonwealth. The major portion of this political unit consists of an "island continent" nearly equal in size to the United States exclusive of Alaska. The first European settlers in most of the colonies were largely convicts sent out from England between 1787 and 1841. For a considerable time very few free colonists went to Australia; as late as 1820 the latter numbered only 1300 as compared with 24,000 convicts. The discovery of rich gold deposits about the middle of the century caused the first great incoming of free settlers, and since then the population has increased almost tenfold (§ 328). A large percentage of the inhabitants live within 300 or 400 miles of the coast, and, mainly on account of adverse climatic conditions, there are vast areas of the interior that probably will never be settled (§ 361).

360. Surface features. The physical features and climatic conditions of the island of Australia have an important bearing upon the life activities of the inhabitants. The major portion of the island lies between the parallels of 18° and 35° S., although the extreme range is from 10° 39' S. to 39° 11.5' S. Considerably over one third of the area is within the tropics; most of the inhabitants, however, are farther south and in the temperate zone. The coast line, excepting on the east and portions of the northwest, is comparatively regular. There are no high mountains; the highest peak, Mount Kosciusko,

is scarcely more than half the height of the loftiest peak in any of the other continents. Broadly speaking, there are three leading geographical divisions,¹ the *eastern highlands*, the *great plains*, and the *western plateau*. The first extend along the east coast in a nearly continuous chain from Cape York to Wilson's Promontory and are generally spoken of as the "dividing range." East of this area are the narrow coastal plains of Queensland and New South Wales. To the west of the highlands and stretching from the Gulf of Carpentaria southward to the ocean are the great plains, which include the basins of the Flinders, Murray, Darling, and other rivers. It is not to be understood that these so-called plains are wholly level, as the name might imply, for here and there are undulating downs, hills, and even low mountains, forming systems of inland drainage. Beyond this region and embracing a large proportion of the whole area of the country is the western plateau, about 1000 feet in height. Here the surface is gently undulating, consisting largely of arid plains.

361. Rainfall. The eastern highlands have an important bearing upon the climate of Australia, for they rob the southeast trade winds of most of their abundant moisture before they reach the interior plains. Consequently, the latter have a scanty rainfall which, broadly considered, gradually diminishes as the great almost rainless district of West Australia is approached. The tropical northern coast is well watered by the monsoons; the extreme south gets most of its rain in winter from the stormy west winds. Those of the west and southwest coasts are warmed in crossing the land, and, with an ever-increasing capacity for moisture, sweep unimpeded over the arid interior. Without entering into details, it may be seen from what has already been said that a vast portion of the country is so deficient in rainfall that it is entirely unsuitable for settlement. Besides, there are large areas, especially in the great plains, where the smallness of the annual rainfall forbids extensive agriculture unless irrigation is practiced, but where it is sufficient for grazing, especially for sheep. Moreover, the temperature is favorable for this industry, and here are found the great sheep runs for which the commonwealth is famous.

362. Rivers. Australia is lacking in any great river systems such as are found, for example, in North America, and this is due to the peculiar topography and climate of the country. The narrow coastal plain is drained by short streams which are of no great commercial

¹ See J. W. Gregory, "The Economic Geography and Development of Australia" in *The Geographical Journal*, Vol. XXVIII, 1906, from which some of the data contained in this chapter have been obtained.

significance. In many cases bars are found at their mouths, formed of sediment brought down from the dividing range. In the interior there are but few rivers, although, as we have seen, there are extensive areas which have a moderate rainfall. Practically the only river that reaches the sea is the Murray, which gets a constant supply of water from the melting snow of the Australian Alps; other streams are of considerable size at times, but during the dry seasons their waters are lost by evaporation or absorbed by the soil. The Murray with its tributary, the Darling, is used for vessels of small draught for inland navigation; but the shallow entrance to the river together with the fact that there is at times but little water in the channel are hindrances to its extensive use. As the resources of the country become developed, these obstacles may be overcome. In the western part of the continent there are no rivers of importance. Along the whole length of the great Australian Bight there is not a single well-defined stream; and this is not surprising when we consider that the scanty amount of rain falls on a comparatively level, sandy surface from which it evaporates before soaking into the soil to any great depth.

363. Pasturage and agriculture. Before undertaking a discussion of the pastoral and agricultural development of this country it may be well to state that the leading animal and plant products are derived mainly from introduced species (cf. § 214). The native flora bear the stamp of prolonged isolation and of long-continued adaptation to environmental conditions (cf. § 133).

"In the more tropical genera the foliage has acquired a tough leathery texture that enables it to resist the wilting effects of excessive evaporation; or its functions are assumed by other organs, . . . ; or again, in virtue of a slight twist of the stalk, it presents no reflecting surfaces, but only narrow edges to the vertical sunlight."¹

The typical Australian animal species, such as the kangaroo and the pouched mole, are found to be as interesting and show the effects of isolation as strongly as the characteristic flora.

Of the introduced animals the sheep is by far the most important, for there is no part of the world better adapted to the production of wool of excellent quality than the grassy plains of eastern Australia, particularly those of Victoria and New South Wales. And the fiber can be produced cheaply, for in addition to other favorable factors the climate is sufficiently mild to permit the flocks to live in the open air during the whole year. From the discussion in the preceding paragraphs it is apparent that much of the settled area of the country

¹ C. H. Barton, in *The International Geography*, p. 581.

has too deficient a rainfall for extensive agriculture. Pasturage, however, especially sheep grazing, can be carried on successfully with much less rainfall than can agriculture, and this accounts, in part at least, for Australasia being the greatest wool-producing region in the world.

Not only do the fleeces of different breeds of sheep vary greatly in their general character, but local conditions affect the quality of the wool as well. As an illustration of this phenomenon it may be mentioned that the Leicester and Lincoln breeds of sheep produce a highly lustrous wool when reared in certain counties in England, but that in other counties the fleeces are far less brilliant. Merino sheep are noted for their excellent fleeces, and they have been introduced into many countries and often crossed with native breeds. In 1797 they were imported into Australia, and two or three years later sheep farms were started and the wool trade founded; as early as 1803 one farmer owned 4000 acres of pasture land and between 3000 and 4000 sheep. England could take all the fleeces that might be produced to feed her expanding cloth-manufacturing plants; hence the wool trade developed with great rapidity, and soon Australia became the source of half the wool produced for the English market. At the present day Australia and New Zealand furnish two thirds of the wool imported into the mother country. New South Wales surpasses all other states of the commonwealth in wool production; yet there are extensive areas where the rainfall scarcely suffices for sheep raising. On account of droughts care has been taken not to stock the land too heavily, and even when this precaution is taken, thousands of sheep sometimes die, and the losses would be even greater were not whole flocks driven considerable distances to better-watered areas. Queensland comes next to New South Wales in wool production, but the fiber of best quality comes from Victoria, "where the quality of the grass and the dryness of the air, in the higher latitude, produce a wool which is almost unsurpassed for softness, lustre, and length of staple."¹ Considerable attention is being given to irrigation, and its extension will affect materially the agricultural and pastoral areas; in this connection it should be said that the building of railways, by which an outlet is provided for perishable and other commodities, and the practice of irrigation have contributed a great deal towards converting former pastoral lands into agricultural districts.

At the close of 1907 the number of sheep in the commonwealth was nearly 88,000,000, and the wool exports for that year had totaled 584,750,000 pounds. Cattle numbered over 10,000,000. A profitable

¹ Lyde, *Commercial Geography of the British Empire*, p. 110.

business which has grown in a short time to large proportions is the preparation of frozen meats for export; dairy products are also a source of considerable wealth, especially in Victoria.

The agricultural districts are limited at present to the well-watered coastal strips and to such portions of the interior as have sufficient rainfall and the necessary transportation facilities to connect them with markets. The fertile peninsulas of the north grow tropical produce such as bananas and sugar cane, but the "tropical labor question" (cf. § 145) acts as a check to extensive production. The farm lands of the cooler south yield various crops grown in the temperate zone; cereals, especially wheat, the vine, and sugar beets, are the principal products. But wheat is not cultivated with marked success, owing to the uncertain rainfall in some seasons, or floods, pests, or scarcity of labor in others. Hence we find that, in some years, wheat and flour have to be imported. With reference to the vine it is stated that "a fair yield of grapes per acre is at least four times as valuable as a good yield of wheat." Whether or not this is literally true, it is clear that certain sections of southern and southeastern Australia are excellently adapted to viticulture; the long root enables the plant to resist drought; the industry calls for a minimum amount of labor; and the soil and temperature are the best that could be desired.

364. Minerals. From the historical standpoint gold is the principal mineral. From the middle of the last century until the present time the value of the output has been more than \$2,500,000,000. In 1851 the industry started at Golden Point, in Victoria, and since that time this state alone has yielded gold to a value estimated at \$1,370,000,000. West Australia now leads in production, and its output of gold is its chief source of wealth. It was not until 1885, when the mineral was discovered in what was known as the Kimberley district, that the yield became considerable.

There are important deposits of copper, lead, silver, zinc, and tin. Copper is found in South Australia and New South Wales. The Wallaroo, Moonta, and Kadina mines of the former produce large quantities of the metal for export. The tin deposits form a part of the great formation which begins in the Straits Settlements, passes through the famous tin-bearing islands of Banka and Billiton, and continues through eastern Australia to Tasmania.¹ Immense quantities

¹ Tin is sparsely distributed throughout the earth. Its chief source is in placer deposits, where it occurs in small particles called "stream tin"; it is found also in veins in rocks, and is then known as "mine tin." Its principal use is in the tin-plate industry. Tin (or tinned) plates are thin sheets of iron or steel coated by being dipped in melted tin, which serves as a protection against rust. Tin plates are

have been obtained from different districts, especially from the Broken Hill mines in New South Wales. These also are becoming famous for the production of lead, and, according to official reports, it is believed that they soon will be reckoned among the world's great producers of spelter (zinc).

Coal of good quality is found mainly in New South Wales, although important deposits occur in Victoria, Queensland, South and West Australia, and Tasmania. In New South Wales the coal fields lie on the east coast, and those which have been most worked are in the vicinity of Newcastle and along the valley of the Hunter River. At present they contribute about 70 per cent of the total output of the state. The location of the coal deposits is almost ideal in that the product can be marketed at a minimum cost; south of Sydney, and in Queensland also, there are easily worked deposits.

The iron deposits are said to be of wide distribution and the ore of good quality. Although comparatively little has been done as yet towards the development of the iron and steel industry, the possibilities for future production at a low cost are promising.

365. Transportation. We have seen (§ 362) that Australia, in striking contrast with Canada and the United States, is notably deficient in inland water ways. This has an important bearing upon the efforts that have been put forth to solve the transportation problem. In the early history of the colonies, on account of the lack of water ways, roads were of primary significance, and they were constructed mainly by the convicts, who were looked upon as public property. The trunk lines were in most cases built by the various states, but the more local roads were constructed by municipal boards. Soon after the discovery of gold in New South Wales a Department of Roads was created, and by 1864 it had under its jurisdiction all the roads of the colony.¹

made in the same way, excepting that they are dipped in a bath containing an alloy of tin and lead. Terne plates, on account of the presence of the lead, are much duller in appearance than tin plates. The former are used for roofing purposes; the latter for making household utensils and cans for preserving such foods as fish, meat, and vegetables. Tin is employed also in making valuable alloys such as bronze, britannia metal, and pewter. The world's annual production is over 100,000 tons. Until two centuries ago the tin mines of Cornwall and Devonshire were about the only ones that were being worked. To-day the chief source of supply is the Straits Settlements, which contributes about two thirds of the whole output. The islands of Banka and Billiton (East Indies) together rival Bolivia for second place, producing about 13,500 tons per year. Other important sources of supply are Australia, Cornwall, and China.

¹ See article by Helen P. Bates on "Australian Experiments in Industry" in *The Annals of the American Academy of Political and Social Science*, Vol. XII, 1898, pp. 193-213.

Railway construction started shortly before the middle of the nineteenth century in New South Wales and Victoria. The first lines were built by private companies, largely for the purpose of providing better means of communication between the grazing lands of the interior and the coast. But the policy of government railways was soon brought forward, and in 1855 the two colonies mentioned above undertook their construction; South Australia followed their example in 1857, and the other colonies a few years later. At first progress was slow on account of financial and other difficulties, but within more recent times the development has been rapid. The dividing range (§ 360), especially that part of it which is in New South Wales, has been a serious obstacle to the establishment of railway communication between the eastern coast and the interior; but this difficulty has been overcome. Unfortunately the different colonies did not build their lines with a uniform gauge, and this makes it imperative, in many cases, to transfer passengers and freight at the frontiers of the various states. On June 30, 1907, the commonwealth had over 14,000 miles of railway in operation, and, with a few unimportant exceptions, all the lines are owned by the government. New South Wales, Victoria, and Queensland each have over 3000 miles of track. The government lines have usually been operated at a loss, but for the year ending June 30, 1906, a surplus was reported.

366. Foreign commerce. Trade is free between the various states of the commonwealth. The United Kingdom has always enjoyed a large proportion of the foreign commerce, while a goodly share of the rest has been with other British possessions. The trade returns of the last two decades indicate that a considerable proportion of the commerce is being diverted to foreign countries. An important factor in effecting this change has been the establishment of direct lines of steamships between foreign countries and Australia in the eighties. However, the major share of the trade is still with the mother country and other British colonies; from 1901 to 1904 the percentage values of the imports from the United Kingdom, British possessions, and foreign countries were 58, 12, and 30 respectively, the corresponding figures for the exports being 47, 27, and 26. An important feature of the new customs tariff of 1908 is a provision for granting a preference to goods produced in the United Kingdom and shipped thence to Australia over similar importations from other countries (cf. §§ 358, 373, 388).

Foreign commerce has grown with great rapidity; at present it amounts to about \$600,000,000 annually, and the exports exceed

the imports. The former are mostly raw materials or foodstuffs, important items being wool (far exceeding all other separate items in value), bullion, breadstuffs, copper ingots, butter, skins, and hides. As might be expected in such a new country, the manufactures are not developed sufficiently to figure to any extent in the export trade. The new tariff as compared with previous ones gives more protection to industries; recently the production of iron and steel from Australian ore has been encouraged by the offer of liberal government bounties (cf. § 353). The leading imports are textiles and other manufactures, tea, tobacco, spirits, and other articles of luxury.

THE DOMINION OF NEW ZEALAND

367. Introductory. The dominion of New Zealand is an archipelago situated in the South Pacific about 1200 miles southeast of Australia, and lying almost entirely between the parallels of 34° S. and 47° S. The major portion of the dominion consists of three islands called the North, South (or Middle), and Stewart Islands; the first two are separated by Cook Strait, which varies from 16 to 90 miles in width. In addition to the three largest islands there are several smaller outlying groups. New Zealand has been known since the middle of the seventeenth century, but it was not until 1840 that the British took formal possession of the islands.

368. Surface features and climate. The coast line, especially on the west, is high and rocky, and of great length as compared with the area of the islands. The surface is mountainous; the ranges stretching through the two largest islands have a general trend from southwest to northeast. In the South Island the principal chain is close to the west coast, but in the North Island it is not more than 50 miles from the east shore. It is often said that New Zealand is the England of the antipodes, and that the English emigrant feels more at home in New Zealand than anywhere else.

Forests abound on the western slopes of the mountains of the South Island, with here and there a fertile river valley or strip of coast land. East of the watershed the lower slopes of the mountains are covered with grasses. The country is considerably broken, but towards the east coast are extensive sections of level country, of which the Canterbury Plains, upwards of 150 miles long and 30 in extreme breadth, are the most important. Much of the reclaimed land of the North Island formerly was covered with dense bush or forests. The country back of Hawke Bay on the east coast is level and fertile; the hilly districts of the west are excellently adapted to pasturage.

New Zealand lies in the path of the "Roaring Forties," which have blown for a considerable distance before striking the west coast, over a shallow sea warmed by equatorial currents. Hence the rainfall is plentiful and the range of temperature from ocean to ocean is slight; the harbors are open the year round. All parts of the narrow islands have sufficient rainfall, although on the west coast it is from two to five times greater than at corresponding points on the east coast. Lakes and rivers abound, but the narrow, mountainous character of the country prevents the latter, with few exceptions, from being of any great commercial value; the Waikato is the longest, and it is navigable for a distance of about 75 miles.

369. Pasturage and agriculture. So far as soil and climatic requirements are concerned, two thirds or more of the area of New Zealand are well adapted to grazing and agriculture; there is never the danger of a drought as in Australia. The land is not of too great value to be used for these occupations, for the islands are very sparsely populated; accordingly, sheep raising with its allied industries and farming are of primary importance. So extensive is the former that wool and frozen lamb and mutton form almost one half of the value of the exports. Only about one third of the available grazing area is occupied, more being utilized in the South Island than elsewhere. The average size of the flocks of sheep is over 1000. The wool clip in 1906 was nearly 176,000,000 pounds, of which about 172,000,000 pounds were exported. Cattle are of secondary importance as compared with sheep, although dairying, especially in the North Island, is an extensive industry.

The annual value of agricultural products is but little short of that of the pastoral industry. Large cereal farms are found in the South Island and in the southern part of the North Island; mixed farming predominates in the northern part of the latter. Practically all the vegetable crops known to the temperate zone are raised in New Zealand; oats and barley are grown in sufficient quantities to allow some to be exported, but in most cases the plant products are sufficient only for the home demand. One of the commercial plant fibers of considerable importance is a characteristic product of this country, the New Zealand hemp, or flax (cf. § 223).

The plant, *Phormium tenax*, from which the fiber is obtained belongs to the lily family and is native principally to New Zealand; the fiber is often and more correctly known as phormium. The plant is grown for commercial purposes only in this country, in the valley of the Waikato River; but it has been introduced elsewhere for

ornamental purposes — along the coast of California and the west coasts of Scotland and Ireland. It is hardy and will stand considerable cold and drought. The fiber is obtained from the sword-shaped leaves, which yield in clean fiber upwards of 15 per cent of their weight when green; it is from 3 to 5 feet in length, comparatively white and fine, and for a leaf fiber (p. 271) is rather soft. It is used for making cordage and binder twine, often being mixed with Manila (§ 323) or sisal (§ 409). If particular care is taken in its preparation, it closely resembles flax (§ 406), and goods made from it are not unlike linen.

370. Forests and minerals. It has been estimated that 20,000,000 acres are still under forest; the native trees include many excellent cabinet and building woods. The most valuable species, characteristic of New Zealand, is the kauri pine, which yields both timber and a valuable gum; it is found on the North Island, especially in the Auckland district. The gum bears a close resemblance to amber and is obtained from the earth on the sites of ancient kauri forests in nuggets which often weigh 100 pounds each; its chief use is in making varnishes, and it is one of the leading exports (§ 373). In the fifty years from 1853 to 1903 the value of the output of gum is said to have amounted to \$57,626,000.

There are more or less extensive deposits of a variety of minerals, but those which are worked are mainly gold and coal. The annual output of the former is nearly \$10,000,000, which is almost 60 per cent of the total mineral production. Although gold is found in both the North and South Islands, the deposits in the latter are the most extensive and are located in the northwest and southeast. As a rule, the coal areas are favorably located in that they are near the sea. The mines most worked are in the western part of the South Island near Westport and Greymouth, although other mines, notably those in the northern section of the North Island, yield large quantities of coal of good quality. The total output has not been sufficient to meet the home demand, and New South Wales and the United Kingdom have been drawn upon to meet the deficiency.

371. Manufactures. From what already has been said regarding the pastoral and agricultural industries, it might be inferred that New Zealand is, in no sense of the word, a manufacturing country. There is, however, a considerable annual output of manufactured commodities, and it is on the increase. According to a report¹ published

¹ *Foreign Commercial Guide*, Part I, section 28, "New Zealand." This report contains a good deal of valuable information regarding the resources, production, and commerce of the country, and has been drawn upon, to a limited degree, in the writing of this chapter.

in 1905 by the Philadelphia Commercial Museums, there were 3900 manufacturing establishments employing 53,000 hands. Over 100 different industries or classes of industries were represented, embracing among others the manufacture of boots and shoes, hardware, flour, woolens, carriages, agricultural implements, furniture, paper, and pottery. In some cases the output is adequate for the home demand, although, as will be seen later (§ 373), manufactured goods form a very large proportion of the imports.

372. Transportation. The rivers, with few exceptions, are used comparatively little for commercial purposes. Roads reach out in all directions from the coastal towns or railway terminals to other centers of population. On March 31, 1908, there were 2587 miles of railway in operation; all of this, excepting 113 miles, is owned by the government. In the North Island, Auckland and Wellington are the principal railway centers. In the South Island a trunk line nearly 450 miles in length runs along the eastern coast from Culverden to Invercargill. Twenty-five or more subsidiary lines, aggregating nearly 850 miles in length, reach out from the main line to the grazing and farming districts of the interior.

373. Foreign commerce. The foreign commerce of New Zealand is growing rapidly and had amounted in 1907 to nearly \$182,000,000; the value of the exports exceeds that of the imports to the extent of about \$13,000,000 annually. The great staple of the export trade is wool; and its allied products, frozen lamb and mutton, take second place. Other leading items are gold bullion, butter, kauri gum, hemp (phormium), sheepskins, tallow, oats, frozen beef, lumber, and cheese. Of the imports, wearing apparel, cotton and woollen piece goods, raw sugar, hardware, galvanized sheet iron, intoxicants, boots and shoes, and tea are leading items. The foreign trade is mostly with the United Kingdom and British possessions; the former has about 70, the latter nearly 20 per cent of the whole, while the United States has not more than about 6 per cent. In accordance with the general plan of Canada and Australia a preferential tariff rate is given to certain imports from the United Kingdom; the act of 1903 provided that 37 lines of listed goods should be allowed to enter New Zealand at the regular rate of tariff if they originated in Britain, but that they should pay an additional duty of 50 per cent if they came from other countries. This regulation and others which were favorable to British goods have tended to increase somewhat the imports from the United Kingdom to the disadvantage of other countries; and a new tariff law of 1907 has extended considerably the list of goods to which a preference is given.

CHAPTER XXV

INDIA

374. Introductory. The British Empire in India consists of the provinces and the Native States. The former are known as British India and are under the direct administration of the crown; the latter embrace between 300 and 400 distinct units, each of which is under a native chief who acknowledges the suzerainty of the British. The approximate area is 1,767,000 square miles and the population is roughly 300,000,000. In British India alone there are upwards of 230,000,000 people, and the average density of the population is over 200 to the square mile; in the Native States the corresponding figure is upwards of 90. In Bengal and the United Provinces of Agra and Oudh, which embrace about one sixth of the total area, are found two fifths of all the people in India. This teeming population, embracing about one sixth of the human race and three fourths of all the people of the British Empire, differs from that of the mother country and the other colonies in many important particulars. Two peoples could scarcely be more dissimilar than the English and the Hindu; their languages are, it is true, of the same family, but in almost every other respect—in tradition, religion, economic and social life—there are vast differences. Comparatively speaking, there is only a handful of Englishmen in India, and any extensive future influx is hindered on account of climatic differences (cf. § 144). The standard of living is extremely low; most of the people are farmers who eke out a bare subsistence on their small holdings. Religious prejudices, forced economy, and the nature of the climate combine to cause 75 per cent of the population to live on a diet which is almost exclusively vegetable; even when famine is pending, death is preferred to the eating of domestic animals. Such a state of affairs cannot help but limit the country's trade and its general material advancement; but, in spite of all the drawbacks of which only a few have been suggested here, India is a country of enormous production even under present conditions, and the possibilities of expansion are promising.

375. Surface features and climate. Broadly considered, India consists of a *triangular plateau*, called the Dèccan, varying from 2000 to more than 3000 feet in height, which lies between the parallels of 8° N. and 25° N. ; and the *low plains* of the great rivers of India, — the Indus and the Ganges, — a region varying from 100 to 400 miles in width. To the north rise the lofty Himalaya Mountains, stretching a distance of 1500 miles with an average width of 150 miles. A dense jungle and spurs of the Himalayas combine to protect the frontier of the northeast, while the Sulaiman Mountains in the northwest, across which are found several passes, of which the Khaibar is the most famous, offer the best method of approach to the country by land. The land boundaries of India combine to exert an important influence upon climate and vegetation and to protect the country from invasion. The route via the Khaibar Pass has been usually selected by the invader, and, quite naturally, it has served as the path of least resistance to the overland trader as well. The triangular plateau, or the Deccan, is more or less inclosed by mountains ; in the north is the Vindhya range, while on the west and east coasts are the Ghats.

Although the country stretches northward nearly 14 degrees beyond the tropic of Cancer, a large proportion of the surface area of India is entirely within the tropics. Consequently, there is a wide range of temperature ; but the climatic element which bears most intimately upon the general life conditions of the people is the rainfall, which is periodic and which varies greatly from year to year. The country is dependent for its rain upon the southwest (summer) monsoon, which strikes the Western Ghats and leaves on the southwest coast an abundance of moisture. Under ordinary conditions the monsoon carries onward to the interior a great deal of moisture, which, since it encounters no important condensing medium, travels to the Himalayas where it is precipitated and finds its way to the ocean through the great rivers of the plains. The northeast (winter) monsoon brings less rain, most of which is condensed by the Eastern Ghats. Not only are there large areas of India where the usual rainfall is insufficient for agricultural purposes, but there are large sections of country where the rainfall is uncertain because of the occasional deficiency of the southwest monsoons. At such times the crops fail in whole or in part and famine ensues. It can be seen that irrigation (cf. § 167) is imperative in such regions, while in others it greatly increases the productivity of the soil. It is highly probable that no country in the world is more dependent upon artificial devices for its food supply than is India.

376. Agriculture. This is by far the most important occupation in India, and strenuous efforts are being put forth to improve farming by the introduction of scientific methods. In each province there are departments of the government which collect agricultural statistics, conduct experimental farms, establish schools, and otherwise endeavor to better existing conditions. But the conservatism of the Hindu is a persistent trait; he uses the same sort of stick for turning over the soil that was used a thousand years before the Christian era; grain is trodden out by cattle, or is winnowed by hand-flails in the ancient way; reaping is still done, as of old, with the sickle or scythe. As some one has phrased it, the Hindu will not "get a move on."¹ Machinery has been introduced to a limited extent, but the small holdings and poor condition of the great mass of the farmers combine to make India far less promising than such a country as Canada, for example, as a field for machine methods.

As regards the agricultural products of this country, it may be said that the diversity of surface features and climate permits the successful cultivation of a large proportion of the crops of both the temperate and tropical zone; of these, only the more important will be referred to in this place. Rice is grown widely, but since it flourishes best in a hot, moist climate, it is cultivated largely in lower Bengal, Madras, and lower Burma. A large percentage of the rice is consumed locally, excepting in Burma, where the comparatively sparse population for a rice-growing region permits a large export amounting in an average year to two thirds or more of the total rice exports from British India. The staple food product of the poorer classes is millet (cf. § 220), while the wealthier people consume wheat and barley. "Probably three fourths of the population of India live on the grain of millets . . . or various kinds of pulse."² Millet thrives in a drier environment than is suitable for rice, and it is grown usually on unirrigated lands in the Deccan, the Punjab, and elsewhere.

Wheat is cultivated in the cooler regions of northern India—the Punjab and the United Provinces.³ There nearly two thirds of the

¹ Kipling's story, "The Naulahka," is a sort of study in contrasts, as between the Hindu and the "hustling" type of the American West. At the head of one of his chapters occurs the following significant summary in verse:

Now it is not good for the Christian's health to hustle the Aryan brown,
For the Christian riles and the Aryan smiles and he weareth the Christian down;
And the end of the fight is a tombstone white with the name of the late deceased,
And the epitaph drear, "A fool lies here who tried to hustle the East."

² Holdich, India, p. 256.

³ The United Provinces of Agra and Oudh were, until 1902, known as the Northwestern Provinces and Oudh.

crop-producing areas are planted with wheat ; other regions, particularly the Central Provinces, have yielded a considerable quantity since direct railway communication has been established with Bombay. The figures in the Appendix ¹ show that British India stands fourth among the wheat-producing countries of the world. If wheat instead of millet were the staple diet of the masses, the whole product would be entirely insufficient for the home demand ; but, in an ordinary year, it is exported to the value of about \$30,000,000.

Of the fiber crops, although the yield per acre is small and the quality is extremely poor, cotton is the most important ; in spite of these drawbacks it holds first place in value among the exports. It is grown extensively in Bombay, Berar, and other parts of the Deccan where the "black cotton soil," which has a remarkable power of retaining moisture, is well adapted to this crop.

The world's crop of jute is produced almost wholly in India, mainly on the sandy soil of Bengal, although smaller quantities are raised in China, Japan, and Formosa. The fiber is obtained from two closely related species of the linden family, *Corchorus capsularis* and *Corchorus olitorius*, which were native in southeastern Asia. The leaves of the latter are used as a vegetable ; among the modern Egyptians and Syrians they form one of the commonest culinary dishes. The jute plant attains a height of from 8 to 12 feet, and it is similar to hemp in general habits of growth ; the fiber in the lower part of the stalk is very coarse, and it is cut off and sold at a small figure (from 1 to 2 cents per pound) as "jute butts." It is used in making paper, cheap twine, and coarse bagging. The rest of the fiber, which is finer, more glossy, and more easily spun, sells for $2\frac{3}{4}$ to $3\frac{1}{4}$ cents per pound and is used for making twines, grain sacks, gunny bags, cotton-bale covering, and rugs. Fabrics made from jute soon lose their usefulness if exposed to moisture, since the latter dissolves the materials which hold the cells of the fiber together. The United States Department of Agriculture has demonstrated the practicability of growing jute in the southern states, but until suitable machinery is invented to separate the fiber from the stalk there is little hope of the jute industry being introduced into this country. No other fiber used in the American textile manufactures is as cheap as jute, and none but cotton and sisal surpass it in quantity manufactured. Over 100,000 tons are imported yearly into the United States.²

¹ Table IV.

² A fiber to which the name Mauritius has been given is grown, for commercial purposes, almost exclusively on the British island, Mauritius. It surpasses other

Oilseeds are an important crop, the area devoted to them being practically the same as that to cotton. Those most extensively grown are flax (cf. § 228), sesame, mustard, and several kinds of rape. By referring to the Appendix¹ it will be seen that India stands fourth among the countries of the world in the production of flaxseed. A large percentage of the oilseed crop is exported, but there is an important business at home in pressing the seeds in the oil mills. The refuse or cake is used as food for cattle, although, in the case of sesame, it is eaten by the people.

Other crops of considerable importance are sugar cane, tea, cinchona, coffee, and poppies. Although sugar is one of the leading imports, over 2,500,000 acres, chiefly in the northern plains, are planted with cane. Tea is grown mostly in Assam. Cinchona, a tropical tree native on the eastern slopes of the Andes, was introduced into India in 1860. Extracts, of which quinine is the best known, are made from the bark; and, on account of its high medicinal value, especially for malarial fevers which are so common in the tropics, it is greatly prized. With a view to providing a cheap and abundant supply of the febrifuge for India, government plantations were started in the Nilgiri Hills in the southern part of the peninsula, and at Darjeeling in the Himalayas. The tree is grown privately also, but much of the bark is sold to the government and treated in the latter's factories. Coffee is cultivated in Madras, Coorg, and Mysore, but the industry seems to be declining somewhat. Poppies are grown in the valley of the Ganges, in the vicinity of Patna and Benares. The manufacture of opium is a government monopoly, and the sales abroad have amounted in some years to about \$30,000,000. The use of the drug for illegal purposes, however, is on the decline.

377. Domestic animals. It has been estimated (§ 238) that British India has even more cattle than the United States; but on account of the fact that in the former country the animals are raised primarily for draught purposes and for their skins, the cattle industry is of less importance than it is in the United States. There are large areas where the rainfall is too scanty for agriculture but sufficient for the rearing of cattle; the most distinctive cattle region is a belt reaching from Cutch to Kashmir. The cow is held in veneration by the Hindus, so that there is always a large number of old, useless animals to be provided for; in years of drought many of these die, as well as millions of milch cows and working cattle. Very little has been done toward the improvement of breeds, such practices not being in line with the religious ideas of the masses. Immense numbers of goats are found in most of the provinces, but the statistics showing their number are not specially trustworthy (cf. § 238).

hard fibers in softness and whiteness. It is used for making such articles as hammocks and gunny bags and when mixed with Manila (§ 323) and sisal (§ 409), it makes cordage of medium grade.

¹ Table VII.

378. Forests and minerals. Teak is the most important wood in India, being found chiefly in upper Burma, on the southwest coast of the peninsula in Bombay, at the foot of the Western Ghats, and in the middle of the Central Provinces. Sal is a valuable wood which grows in the United Provinces, Bengal, and Assam. Sandalwood occurs in the southern part of the peninsula, especially in Mysore and Coorg. Cedars and other conifers make up the bulk of the forests in the Himalayas.

There are extensive deposits of several important minerals, but, as yet, they are poorly developed. Gold, coal, iron, petroleum, and manganese are among those which have been most worked. Coal is widely distributed, the principal deposits being in Bengal and in central India; the former are being exploited more than others, and their output is increasing. The coal is sent to various parts of India for industrial purposes. The region which has produced the most gold is Mysore, but the output is not sufficiently large to give India rank among the important gold-producing countries. The principal iron deposits are in Madras (chiefly at Salem), in the Central Provinces, and in Bengal, in the vicinity of Raniganj. Smelting according to modern processes has not been introduced extensively, owing partly to the fact that coal, iron, and limestone are not in juxtaposition, and to the poor quality of the native coal for smelting purposes. The oil fields are mainly in Burma, although Assam and other provinces have more or less extensive deposits of petroleum. The manganese fields of Mysore are being worked more in recent years than formerly, and new deposits have been found, chiefly in the Central Provinces.

379. Manufactures. India has long been famous for its native craftsmen skilled in manufactures of silks, metals, wood, and ivory; in many cases, however, the former high standard of artistic excellence is being lost. This is probably due to a variety of causes, among which the heavy influx of cheaper factory products from other countries and the establishment of manufacturing plants in India are to be reckoned with. The weaving of cotton cloths has always been an important industry, but since the establishment of cotton mills, the hand-loom workers are being forced to resort to the making of goods with an intricate pattern which the power looms cannot profitably manufacture. The Hindu is fond of plain household vessels made of brass, but handmade ornamental bowls and vases are also in great demand both at home and abroad, and probably will be for a long time to come. Metal working and other industries such as wood and ivory carving seem to have a promising future, but here, as in many other lines of manufacturing, the skilled handworkers are scarcely able to meet the competition of native and foreign machines.

Manufacturing according to modern methods is being extended in India into many branches of industry, and cotton, jute, woollen, and paper mills, tanneries, and iron and brass foundries have already been established. The output, however, is extremely small when the

enormous size of the population is considered. Of the various manufactures cotton deserves particular mention. The first cotton mill was established near Bombay soon after the middle of the nineteenth century, and in spite of various difficulties encountered, the industry has developed until there are now over 200 mills in India with upwards of 5,500,000 spindles and over 60,000 looms. The principal seat of the cotton manufactures is on the west coast, in Bombay Presidency, where nearly three fourths of the mills are found, one half of the entire number being on Bombay Island. The special advantages of this region are due to the fact that the raw cotton is near at hand, and that the port of Bombay is conveniently situated for receiving the machinery and other mill supplies from Europe as well as for shipping the manufactured product. A serious drawback, however, is that coal has to be brought from Bengal; the mountainous back country, besides, makes access to the interior rather difficult. Labor is very cheap but it is not efficient. Notwithstanding the progress of the cotton-manufacturing industry, cotton goods and yarns form the greater share of the imports, although the exports of domestic yarns, mainly to China, and of cloth to the Straits Settlements and China, have an annual value (1906) of nearly \$47,000,000.

380. Transportation. Until half a century ago the system of land transportation was most primitive, as of course it is to-day in many districts. Human carriers, pack bullocks, or rude wagons drawn by cattle were the leading commerce carriers excepting where navigable streams might be found; on the latter boatmen plied their traffic, especially on the water ways of the great plains to the north. But the advent of the railway and of other modern methods of internal communication has caused thousands of cartmen and bullock owners to desert their former occupation, while at the same time thousands of boatmen and boat builders have lost their means of support.

On the plains of the north there are no great natural obstacles to communication, so that railway building is comparatively easy. The rivers, especially those of the Ganges basin, afford good natural water ways, but the competition of the railways has diverted a goodly share of the traffic excepting that in the more bulky goods. To the northeast, however, the steamers on the Brahmaputra are the principal commerce carriers. On account of the frequent shifting of the channel of the Indus and the obstructions caused by the accumulation of sand, this river is now used but little by steamers. The surface conditions in the Deccan make communication between the coast and the interior difficult in many cases; as a rule, the rivers

are not navigable on account of rapids and recurrent seasonal floods, or scarcity of water at other seasons, while often they make their way to the sea through gorges too narrow to permit the easy building of a railway. Some of the numerous irrigation canals (cf. § 167) are used also for navigation.

The development of the railway net has been tolerably rapid when we consider the difficulties encountered in constructing new lines in a country where the people are poor and where it is hard to make the roads pay. In 1853 there were only 20 miles of railway, but to-day there are about 30,000 miles in operation. The lines serve both commercial and military purposes; some of them converge on the northern and northwestern frontiers, so that in case of threatened invasion the army could quickly be transported thither (cf. § 375). The government owns the larger part of the railway mileage and the whole system is under state authority. There is no uniformity of gauge; in India the standard means $5\frac{1}{2}$ feet (cf. § 298). The meter gauge is more common than any other both in British India and in the Native States. The usual disadvantages of a mixed system of gauges is experienced, but there seems to be no promise as yet of an adjustment to a uniform type.

381. Foreign commerce. The foreign commerce is carried on through a limited number of seaports of which Bombay, Calcutta, Madras, and Karáchi are the most important; from these centers railways reach out to important points in the interior. On account of natural obstacles (§ 375), the overland foreign trade is but a small fraction of the whole.

The predominance of agriculture as compared with other industries accounts for the general character of the Indian exports, whose annual value, exclusive of gold and silver, totals over \$500,000,000. About the only manufactured goods which figure in the exports are jute (bags and cloth) and cotton (yarn and piece goods), which hold the third and seventh places respectively in the list of exports arranged according to value. The large number of domestic animals, especially cattle and goats, accounts for the fact that hides and skins occupy an important place (the sixth). The leading item is raw cotton, which, to the value of between \$70,000,000 and \$80,000,000 annually, is exported to the manufacturing countries of Europe, chiefly Germany and Belgium, and to Japan. Rice, raw jute, and seeds (chiefly oil-seeds) hold the second, fourth, and fifth places respectively. Other important items are tea, wheat, opium, lace, wool, coffee, and indigo.

As might be expected from what has been said in the foregoing

paragraphs, the imports consist largely of manufactured goods. Of these cotton easily takes first place with an annual value of approximately \$150,000,000, which is about one third of the value of all the imports. Next in order of importance are metal manufactures, consisting of iron and steel, railway material, machinery, hardware, and cutlery, with an annual value not far from \$75,000,000. Sugar is by far the largest item among the commodities imported for food and drink, amounting, in spite of the large home production of cane, to about \$30,000,000 yearly. Woolens, silks, provisions, boots and shoes, glassware, spirits, drugs, and chemicals are important imports.

Nearly 70 per cent of all the imports are supplied by the United Kingdom ; in such lines as cotton manufactures nearly the entire quantity purchased abroad comes from England, whose merchants reap large profits from the trade. On the other hand, the exports are sent to many countries, only a little over 25 per cent of the total export trade being with the mother country.

CHAPTER XXVI

SOUTH AFRICA

382. Introductory. The continent of Africa has an area of over 11,500,000 square miles, or approximately three times that of Europe. Roughly, it lies between the parallels of 35° N. and 35° S., and on account of its general shape, a large proportion of its area is within the tropics. Africa is sometimes spoken of as the continent of plateaus. Of these, broadly considered, there are two,—a higher southern triangular section and a lower northern oblong-shaped region.

"Drawing a curved line from the coast of the Red Sea in the east to the head of the Gulf of Guinea in the west, we may say that whereas land over 2000 feet above the sea is the exception to the north, to the south it is the exception to find land below that elevation except close to the coasts."¹

Already it has been pointed out that Africa affords a typical case of an isolated continent (cf. § 170), and its importance as a contributor to the wares of foreign commerce is comparatively small. Yet behind all other motives in the taking possession of territory in Africa was that of trade. A glance at a political map of the continent will show the holdings of the various European powers and the location of the independent states as well. France has under her flag the greatest area, but a large proportion of this is the Sahara desert. Great Britain is the next largest holder of territory, and it is generally conceded that hers is the most valuable of all. The British possessions are not confined to any one section of the continent, but those of most importance are in South Africa.

383. Extent of British South Africa. The British possessions in South Africa now extend northward from the extreme south of the continent to lakes Nyassa and Tanganyika. Here are included Cape Colony, Natal, the Transvaal, Orange River Colony, the Bechuanaland Protectorate, Basutoland, Swaziland, Rhodesia, and the British Central African Protectorate. British South Africa, which is the main subject under discussion, is taken here to include all of this territory excepting the last-mentioned division; its area is roughly ten times that of the United Kingdom. Some may choose to place the northern boundary at the Zambezi River.

¹ The International Geography, Chap. XLVIII, p. 890.

The Dutch were the first Europeans to establish themselves in South Africa when, in 1652, the Cape of Good Hope was made a permanent port of call for their vessels passing back and forth between Holland and the East Indies. The Cape was seized by the British in 1795, restored to Holland by the Peace of Amiens, and recaptured later by the British, who finally came into its possession by purchase in 1814. At this time the northern boundary of the colony was represented roughly by a line stretching from the mouth of the Great Fish River on the east to the parallel of 30° S. on the west coast. For a long time expansion northward into the unknown wilds proceeded slowly; but commencing about thirty years ago, when the scramble for territory in Africa began in earnest, vast regions were acquired either by annexation or by treaties with native chiefs. And finally, at the close of the South African War, the Transvaal and the Orange River Colony, two former Boer republics, were secured, and Great Britain found herself in possession of the wide extent of territory in South Africa which has been spoken of above. Arrangements are in progress for the federation of the four self-governing colonies — Cape Colony, Natal, the Transvaal, and Orange River Colony — and for the later admission into the union of other British possessions in South Africa.

384. Surface features and climate. British South Africa is a part of the great southern plateau (§ 382). The semi-circular coastal plain is narrow, and from it the rise to the plateau, which varies from 3000 to 5000 feet in height, is rapid. Mountains inclose this great elevated area, so that the whole of South Africa has been likened in general appearance to an inverted saucer. The highest mountains are in the east, and, in fact, the southern section of the great plateau has a general trend westward. The altitude of South Africa has an important bearing upon temperature, so that a considerable proportion of the area is milder than many other parts of the world in the same latitude.

The topography of the country greatly affects the distribution of the rainfall. The rain-bearing winds come from the Indian Ocean, and these are robbed of a large part of their moisture, as they pass inland, by the eastern highlands. Consequently, there is, roughly speaking, a gradual diminution of rainfall as the distance from the east coast increases. There are large areas which have a deficient rainfall, and desert conditions prevail in the western section of the plateau. In the extreme southwest there is a small region which gets considerable rain in winter from the anti-trades.

385. Pasturage and agriculture. From what has just been said it is clear that South Africa is better adapted to grazing than to agriculture. The latter can never be carried on extensively unless large sums of money are expended upon irrigation works, and, in fact, grazing is precarious in large sections of the country not possessing irrigation. The rearing of cattle, sheep, and goats is carried on extensively, but wool growing is the most important interest in the whole grazing industry. The output of dairy products is inconsiderable, and much butter and condensed milk are imported; creameries are being started, however, in Cape Colony and elsewhere, and strenuous efforts are being made to stimulate the dairy industry. The rearing of ostriches has developed into an important occupation in Cape Colony. The parts of the country best suited to agriculture are those where the rainfall is heaviest, that is, in the extreme southwest and in the south near the coast. Here wheat, maize, and practically all of the other crops of the temperate zone may be raised. The production of grapes on the northern slopes of the hills in the suburbs of Cape Town, and to the east or northeast of the city, is one of the most important occupations in the colony. These are largely marketed in London during the winter season before Australian grapes arrive, although a share of the crop is retained and manufactured into wine. Tobacco is grown in large quantities chiefly for local consumption; its quality varies greatly according to soil and climatic conditions, the best being grown in the Transvaal, although that of some parts of Rhodesia is of excellent flavor. Cotton is raised, especially in Rhodesia, where the natives manufacture from it "a rough but lasting material"; experiments are being made with both American upland and Egyptian cotton with a view to their introduction into South Africa, for it is believed that large areas are well adapted to cotton cultivation. It should ever be kept in mind, however, that pasturage and not agriculture is the characteristic industry of South Africa, and that cereals and other foodstuffs are large items among the imports.

386. Minerals. The great source of wealth in British South Africa lies in the minerals. The gold and diamond mines are famous the world over, and there are also valuable deposits of coal, iron, and copper. The Transvaal seems to be the richest in minerals of any part of South Africa, although the output of gold far exceeds all others in value. Gold occurs in the form of alluvial deposits, quartz reefs, and beds of conglomerate rock. The latter are known locally as "banket." In 1884 the famous Rand field was discovered in the Witwatersrand, a long rocky ridge which rises to a height of 1000

feet or more above the surrounding country. The gold-bearing rocks are a conglomerate, and the metal is pretty uniformly scattered through them; the field is known to extend over 60 miles in length, and the mines can be worked to a depth of from 4000 to 5000 feet. Thus there is no danger of the field becoming exhausted in the near future, and the installation of costly machinery is not a mere speculation. Steady dividends can be paid only by highly organizing the business in every detail, for, contrary to the common belief, the formation is of comparatively low grade. The labor problem has, in recent years, been one of the greatest difficulties confronting the managers. Upwards of 100,000 unskilled laborers are required in the Rand mines alone, and it is necessary that the rate of wages should be small in order that the mining operations may be made to pay. The difficulty of obtaining a sufficiently large number of negroes (Kafirs) at the close of the Boer War resulted in the importation of Chinese laborers, but this arrangement was not found to be satisfactory. In 1898 South Africa took first place from the United States in gold production in consequence of the output of the Transvaal mines. The war which quickly followed caused the yield to shrink considerably during the next few years, but by 1905 South Africa again took the lead (§ 257). Within recent years it has been found that southern Rhodesia has valuable gold deposits and their output is increasing rapidly, amounting now to over \$10,000,000 annually.

Diamonds stand next to gold as the most important mineral product. The richest mines in the world are in the neighborhood of Kimberley in Cape Colony; they were discovered in 1867. A few years ago another important mine was opened about 20 miles northeast of Pretoria in the Transvaal. The value of the diamonds exported from British South Africa is upwards of \$40,000,000 annually. Cape Colony alone contributes about 75 per cent and the Transvaal in the neighborhood of 20 per cent of the value of the total export.

Coal is mined from extensive deposits in the Transvaal and is supplied chiefly to gold-mining plants and railways. The quality of coal in Cape Colony is poor and only a small quantity is produced. In Natal and Rhodesia there are important fields which are being worked, largely, however, to meet local demands as in the Transvaal. So much attention is given to gold and diamond mining that the efforts to exploit other mineral resources are relatively unimportant.

387. Transportation. South Africa is deficient in navigable water ways. The only river of any considerable size lying toward the south

is the Orange, but it is navigable for only a short distance. The Zambezi reaches the sea through Portuguese territory, and in its lower course navigation is obstructed by rapids. Most of the other rivers rise on the seaward side of the mountains, so that they are short and rapid, and consequently of little use for commerce.

"Everywhere in Southern Africa the ways of ancient barbarism and those of modern civilization exist side by side. So, too, it is with the modes of travel and transport. Throughout this vast region the open steppes, the jungles, and the forests are intersected by the innumerable narrow tracks worn by the naked feet of the savages, who for countless generations have journeyed along them pack-laden in single file. Everywhere, too, are to be seen the broader, deep-rutted, often very rough roads made by the passing of the heavy wagons drawn by long teams of oxen, with which, even as in the early colonial days, white men still carry on the transport of goods, and travel for immense distances into the wilds."¹

The surface features of the country (§ 384) are such as to make railway construction difficult, and all the lines running from the few shipping ports to the interior have heavy grades. The same is true of many of the roads of the plateau. Railway construction seems to have started about 1860. The subsequent discovery of the diamond and gold mines greatly stimulated the building of lines to the interior. Within the last two decades thousands of miles of new track have been laid, so that at present the mining districts and most of the other important centers are connected with the seaboard by rail. Some of the lines were constructed by the various colonial governments and still belong to them, while others are owned by private companies.

388. Foreign commerce. The annual value of the foreign trade of British South Africa is upwards of \$350,000,000, the exports exceeding the imports. From what has been said regarding the natural resources of the country and what is being done towards their exploitation, it might be inferred that mineral and animal products would form the greater proportion of the exports, and this is the case. Gold and diamonds together constitute about 80 per cent of the total value, although the former greatly exceeds the latter. In 1907, when all the exports were valued at \$235,501,264, the figure for gold alone stood at \$143,612,606, of which over \$133,000,000 came from the Transvaal. The next largest item is wool, while ostrich feathers, hides, and skins come next in order. About four fifths of the exports are shipped through Cape Town, which is connected by railways with the great mining centers. Most of the exports are sent to the United Kingdom.

¹ E. F. Knight, *Over-Sea Britain*, p. 54.

On account of the comparatively slight development of manufactures, a large proportion of the imports consists of manufactured goods. Among the leading imports of this order are machinery (largely for mining), cotton piece goods, blankets and hosiery, apparel and slops, leather and its manufactures, and hardware and cutlery. Foodstuffs also are brought in in considerable quantities. Nearly 60 per cent of the imports come from the United Kingdom and an additional 10 per cent from British colonies; a preferential tariff rate is given to imported goods of British origin.

THE GERMAN EMPIRE

CHAPTER XXVII

GERMANY

389. Introductory. The German Empire, popularly known as Germany, embraces an area of somewhat less than 210,000 square miles, or approximately one and seven-tenths that of the British Isles. In addition, there are various over-sea possessions which have been acquired in recent times, but which from our standpoint are comparatively unimportant (cf. § 400).

390. Causes of recent industrial and commercial expansion. Before undertaking an examination of certain important features of the present-day production and trade of Germany, it is necessary to consider briefly the causes for the recent industrial and commercial progress. It is a well-known fact that, until the beginning of the last third of the nineteenth century and until even later, the German states were mainly agricultural, and that manufacturing was at a low ebb. Since that time the country has undergone a great transformation in its economic life — a change which took place in England a century earlier. Agriculture has declined in relative importance; manufactures and commerce have expanded with such astonishing rapidity that Germany now stands in the front rank among the leading commercial nations of the world. It must be frankly admitted at the outset that such a startling phenomenon cannot be explained by an appeal to the physical environment. The natural resources of Germany are by no means above the average; the fertility of the soil compares unfavorably with that of neighboring countries; the mineral wealth, though great, is below that of the United Kingdom, and the coal and iron deposits are less favorably located than are those of the British Isles. The geographical position is a great disadvantage in the development of shipping and transoceanic commerce, for Germany lies "cooped up" in the northwestern part of Europe. In spite of all these handicaps, Germany has, within recent years, experienced an industrial and commercial expansion which has raised her superior to all her continental neighbors, and which has attracted the attention of all the world.

In obvious explanation of this phenomenon, however, two primary causes stand out above all others — the establishment of national unity in 1871, and the racial character of the Germans themselves.

391. The political factor. In the early part of the nineteenth century Germany was still broken up into a great number of small states, a condition which hampered greatly the economic development of the country. There was no general uniformity in a number of the important factors of the commercial organization which make for advancement ; different coinage systems, a multitude of laws concerning bills of exchange, and nearly a score of different postal systems were to be found. But perhaps the greatest hindrance of all was the great number of customs tariffs ; of these each state had its own, and it is said that from 15 to 20 different tariff boundaries had to be crossed by goods sent from the frontier of Germany to the center of the country. It can readily be seen that the collection of numerous customs dues resulted both in a hindrance to the rapid transit of merchandise and in an increase in its price. These difficulties were overcome, to a large degree, by the formation of the *Zollverein*. This was a customs union, which by 1834 included about two thirds of the area which was later embraced in the German Empire. Free trade existed between the various states in this union, while a common tariff was levied at the frontier. The *Zollverein* paved the way, so to speak, for a remarkable development, when, later, political unity had been brought about. In the meantime progress was slow : wars reduced the population and destroyed accumulated wealth ; there was a continuous strife of petty local interests, and everything was narrow, local, and self-centered. "The best energies of the people were absorbed in the great political conflicts out of which united Germany was to merge."¹ The war with Austria in 1866, which left Prussia free to lead in the unification of the various states, and, quickly following this, the war with France, which welded the German nation into a coherent whole, opened the way for commercial expansion.

"The direct gains which Germany made in the war with France, the acquisition of the rich provinces of Alsace and Lorraine, and the receipt of about \$1,000,000,000 as a war indemnity, were large, but still they were less than the indirect results : the establishment of national unity on a lasting basis, freeing the people from political anxieties, and encouraging them to face their economic problems with a new energy and pride in their strength, and with a new hope in the future. This political factor, vague and intangible as it may be, is still more important ; without it the recent economic development of Germany could be regarded only as a miracle."²

¹ Day, A History of Commerce, p. 399.

² Ibid., p. 399.

And at the historic juncture rose the great man — Bismarck — who led, often with duplicity, but always with force, in the direction of the development of national tendencies.

392. Influence of racial characteristics. But another factor which has already been suggested — the racial character of the Germans — must be taken into consideration here. Centuries of struggle against the rigors of a not too favorable environment, and with other nations in numerous wars, have bred in the race a hardihood and endurance which are of great economic advantage.¹ Again, the natural increase of numbers has been great; in 1870 the population of Germany was less than 41,000,000, while at the present day it is about 60,000,000. This condition has not been without its effect upon the life activities of the people; "the pressure of an increasing population on the resources of a country is one of the most compelling causes of industrial progress."² Among the so-called upper classes there is an earnest effort put forth so to train the children who are to engage in business that they may be prepared to take eventually the most responsible positions. The facilities afforded for such training are excellent (§ 393), and by the young German no opportunity is lost to push himself ahead so that he may maintain his position in the same social class with his parents. A further race characteristic which contributes no small amount to economic progress is the readiness to organize and co-operate for common advancement. In the particular field of finance the Hebrew element of the population plays an important part. It has been said that the Jew is "the commercial leaven of the German nation." And whether or not this saying is accepted as it stands, it has to be admitted that considerable credit must be given to the Jews for the recent expansion of Germany. Finally, it should not be overlooked that the effect of the admixture of other racial elements, in particular those entering with the French, has been to produce certain characteristics which are indispensable to the successful business man.

393. Other factors in economic progress. In addition to the two causes which we have designated as primary, there are other factors which have contributed greatly toward the recent economic expansion of Germany. Of these the technical school should be mentioned among the first. There seems to be a deep-rooted national belief in the value and necessity of technical training; these schools have not been sporadic, for the best of them were established long before Germany entered the struggle for commercial supremacy. At the

¹ See Howard, *The Cause and Extent of the Recent Industrial Progress of Germany*, p. 76.

² *Ibid.*, p. 77.

present day they are to be found in all the important towns, and they afford instruction, at low cost, in all matters relating to industry and industrial art. In Saxony, probably more than in any other German state, "technical education may be said to have passed into the very life of the land and its people."¹ Here are to be found no less than 360 special schools engaged in giving technical instruction to meet the special needs of the people.

Again, there is probably a more intimate relationship between science and practical industry in Germany than is found in either England or the United States. For decades the leaders in scientific theory, the Germans have not been slow in practical applications.

"The German industries very frequently have laboratories with corps of regularly employed scientists in connection with the plant, or they pay retaining fees to professors of science in the universities, who are regarded as technical advisers, and who are under contract to give to their clients the benefit of any discoveries they may make. Laboratories in connection with industrial establishments are not confined to Germany alone, but in that country they are more highly developed than anywhere else, and that is the way by which the Germans are able to get so much good out of their superior technical education."²

394. Agriculture in general. In spite of the great advancement of industry since 1871, agriculture is still an important occupation, and the agricultural interests have entered largely into German politics and commercial policy. Large quantities of farm products are raised; in many cases, however, these have to be imported extensively to meet the demands of the increasing population (cf. § 399). Most of the crops of the temperate zone are cultivated. Germany is one of the greatest producers of hops, while more potatoes are raised than in any other country in the world; the latter are consumed in great quantities by the peasantry. Wheat and oats are grown to a considerable extent, although rye is the most important grain, because it is such a popular and commonly used breadstuff. This makes rye a characteristic cereal of Germany, and, with the single exception of Russia, this country far surpasses all others in its production; of a consequence it will be treated here somewhat in detail, and with it the sugar beet, for in the manufacture of beet sugar Germany takes first place.

395. Rye. Rye, belonging to the same tribe as wheat and barley (§ 218), is more closely related to the former than to the latter. The general structure of the two grains is similar, but under the

¹ Dawson, *The Evolution of Modern Germany*, p. 97.

² Howard, *The Cause and Extent of the Recent Industrial Progress of Germany*, p. 87.

microscope striking differences in the cells become apparent. Moreover, further differences occur in their chemical composition, rye containing a smaller percentage of protein and fat than wheat. The cereal offers a noticeable contrast to wheat and barley in that the beginning of its cultivation was comparatively late; neither the remains of the lake dwellings nor the Egyptian monuments seem to have contained rye; the ancient Greeks did not know it, nor was it cultivated in the Roman Empire much before the beginning of the Christian era. It may have been cultivated previously, however, in Russia and Tartary. Its original home, though not located with absolute certainty, was probably in the region between the Austrian Alps and the north end of the Caspian Sea.¹ Both spring and winter varieties are common, the latter predominating. It is one of the hardiest of cereals, and will grow on poorer soil and in a more severe climate than will wheat.

Formerly rye was extensively used as food by man; this is still the case in parts of Europe, particularly in Scandinavia, northern Germany, and parts of Russia, where as "black bread" it forms the principal food of the peasants. In the early history of the United States bread made from mixing rye with maize is found to have been a common article of diet. Its present use, excepting in northern Europe, is chiefly for stock food and for the manufacture of liquors, such as whisky in America and vodka in Russia. The straw, which is long and tough, is well adapted for braiding and is used extensively in making hats and also to some extent for mats and ropes.

The world's annual rye crop is over 1,500,000,000 bushels. From the figures of the average yield from 1903 to 1907 inclusive, as shown in the Appendix,² it appears that over 95 per cent of the world's rye is produced in Europe. Russia and Germany lead all other countries, with a combined output which has not fallen below 1,000,000,000 bushels for several years.

In the United States the area devoted to rye is comparatively small, averaging during the past ten years less than 2,000,000 acres, or one twenty-third of the area sown with wheat and one fifteenth of that sown with oats. The total production for the past ten years has varied from 24,000,000 to over 33,500,000 bushels. Wisconsin, Pennsylvania, New York, and Michigan have been the largest producers, contributing more than one half of the total yield.

396. Sugar beet. Sugar is a commodity widely distributed in the vegetable kingdom; it is essential to the life conditions of plants, many of which keep their reserves of food stored away in the form

¹ De Candolle, *Origin of Cultivated Plants*, pp. 372-373.

² Table XXI.

of starch which is converted into sugar before being utilized. Within the tropics various species of palms contain a sweet juice, which is used locally as a source of sugar; in Canada and in the northeastern part of the United States the sap of a species of maple is used extensively for sirup and sugar. Of all the saccharine substances honey was probably the earliest known. Without mentioning the other numerous sources of sugar, it may be said that, by a process of selection, two plants have emerged from the host of sugar yielders and have come to form the source of practically all the sugar of commerce. These are the sugar cane and the sugar beet. Not until the middle of the last century, however, did the latter rise into prominence. Its advent has wrought far-reaching changes in the whole sugar industry, which in turn have reacted upon the economic life of millions of people. A few generations ago sugar was an article of luxury; to-day it is a staple article of consumption in most of the civilized world. Tariff schedules dealing with sugar and its products have received much attention from the taxing agencies of modern states. The great expansion of the sugar-producing industry beyond its previous tropical field to the great agricultural areas of large parts of the temperate zone has brought about changes of more than local significance.

The sugar beet is a variety of the common beet (*Beta vulgaris*), which occurs wild over extensive areas, particularly around the Mediterranean and Caspian seas, in Persia, and possibly as far east as India. In its natural state the plant has a fleshy root with a diameter of about one inch; from it, by a process of breeding and selection, have been derived the various varieties of table beets, mangel-wurzels, and sugar beets. Its cultivation reaches back to the fourth or fifth century before the beginning of the Christian era. It is a biennial, storing up in the fleshy root, during the first season's growth, a large reserve of food, which, in the natural course of events, would be used by the plant during the second season in bringing forth flowers and fruits. But man intrudes and appropriates, either for his own use or for the food of his stock animals, the savings of the first year's toil of the frugal plant.

The climatic environment best adapted to sugar-beet production is found in north temperate latitudes; considering temperature alone, the plant attains its best development for sugar-producing purposes in a zone of varying width, through the center of which passes the isothermal line of 70° F. for the months of June, July, and August.¹

¹ H. W. Wiley, "The Sugar Beet," in *Farmers' Bulletin No. 52* (1901), United States Department of Agriculture.

A greater tonnage of roots per acre can be obtained in a warmer environment, but the beets there produced are likely to be less rich in sugar and less adapted to its manufacture than are those grown where it is cooler. As regards soil, any type adapted to the growth of the ordinary farm crops, such as wheat, maize, or potatoes, will yield a good crop of sugar beets, provided there is good drainage.

Towards the close of the sixteenth century it was known in Europe that the beet contained sugar, but it was not until near the middle of the eighteenth century that the idea of deriving commercial sugar from the beet was put forth. In 1805, for the purpose of making sugar from the beet root, there was established in Silesia a factory capable of consuming 525 tons of roots annually. The Napoleonic era and its policies naturally stimulated beet-sugar production on the continent; but with the fall of Napoleon cane sugar was again imported, and it was not until 1825 that the young industry was fairly established in Europe. Even as late as the middle of the nineteenth century the world's beet-sugar product was comparatively insignificant, amounting to little more than 200,000 tons annually, whereas the total sugar production was then about 2,000,000 tons.

At present the world's total commercial cane- and beet-sugar output varies from 12,000,000 to nearly 15,000,000 long tons, the two varieties contributing about the same amount, as is shown by the figures in the Appendix.¹ From these it appears that Asia and North America are the great sources of cane sugar, while as yet Europe has a practical monopoly of the beet variety. The principal seats of the manufacture of beet sugar in Germany are Prussian Saxony, Hanover, Brunswick, Anhalt, and Mecklenburg, and for the most part the beets are grown in the neighborhood of the factories. Next to Germany, Austria-Hungary and Russia are the principal beet-sugar-producing countries. At present the United States produces a comparatively small amount of beet sugar—only about 400,000 tons annually; the states of largest yield are Colorado, California, Michigan, Utah, and Idaho. The possibility of increasing the home production of sugar so that, with the foreign possessions, the United States may become practically independent of the rest of the world in this, her now largest import, is exceedingly promising.

397. Manufactures. Probably the industrial development of Germany can best be illustrated by a sketch of a few typical lines of manufacturing. It should ever be kept in mind, first of all, that the wealth of coal and iron has favored the development of industry. The

¹ Table XXII.

principal coal fields are those of the Ruhr, in Westphalia; of the Saar, between the Rhine and the frontier of France; of Upper and Lower Silesia; and of Saxony. Of mineral products coal easily takes first place in value. Important iron deposits are found in Alsace-Lorraine and in Luxemburg; the present-day output of iron ore is about four times as great as it was thirty years ago. As a rule, however, it costs considerably more in Germany than it does in England to assemble the raw materials for the production of pig iron; in this connection it has been estimated that the item of transportation amounts in the former country to nearly 30 per cent of the cost of production as compared with about 10 per cent in the latter. About 40 per cent of all the pig iron made in Germany is produced around Dortmund in the Rhine-Westphalia district. The manufactures of iron and steel and their finished products are of primary importance and their growth has been rapid; at the present day Germany stands next to the United States in the annual output of pig iron and of steel. There has been an enormous development in the manufacture of machinery, of structural steel, and of rails, due to the great demand of both the home and the foreign markets; the famous Krupp gun manufactory may be taken as an example of enterprise along this line.

In the manufacture of chemicals¹ Germany easily surpasses every other country in the world, a supremacy which may be attributed, in a large degree, to the excellent system of technical education (§ 393). Another advantage is the abundance of certain basic raw materials such as salt, sulphur, and limestone. The value of the yearly output of chemicals is upwards of \$300,000,000, or more than the value of all the machinery manufactured in a single year. In the production of dyestuffs from coal tar, a formerly worthless by-product of gas and coke manufacture, the Germans have a practical monopoly, their factories showing an output equal to 80 per cent of the world's production of chemical dyes. This industry has been developed since 1860, for at that time Germany had to import almost all the dyes (of organic origin) that she consumed, and the value of these imports was over \$12,000,000. To-day not only have the imports been reduced to practically nil, but nearly \$250,000,000 worth of dyestuffs are exported, and an enormous local demand is satisfied as well. Vegetable indigo also has been supplanted by an artificial product; the discovery of the process by which it can be manufactured was made in 1897. The great importance of the chemical industry to the country

¹ See Howard, *The Cause and Extent of the Recent Industrial Progress of Germany*, Chap. IV, where the growth of certain typical industries is discussed.

is further shown by the fact that other industries have derived immeasurable benefit from it through the applications in their fields of chemical science; in addition, great wealth is now produced from materials which a few years ago were regarded either as nuisances or as useless.

The textile trades have undergone a great expansion since 1870, and, to meet the growing demand, fibers are imported in immense quantities. Practically all of the cotton comes from the United States; the principal seats of its manufacture are in Saxony (Chemnitz and Zwickau), Alsace-Lorraine (Mülhausen), and at various centers in the Rhine Provinces and Westphalia. The principal textile plants are on or near the coal fields (cf. § 337). Until about half a century ago the spinning and weaving were carried on largely as household industries (cf. § 335), but to-day enormous factories equipped with the most improved machinery are the principal homes of these processes. The leading centers of the woolen manufactures are in Saxony and Silesia (Chemnitz, Liegnitz, and Görlitz), near where the excellent domestic wool is raised, and in the Rhine Provinces and Westphalia (Aix-la-Chapelle and Barmen-Elberfeld) where foreign wools are manufactured. The production of silks and velvets is centered at Krefeld, which, next to Lyons in France, is the greatest silk-manufacturing city in Europe.

398. Transportation. A glance at an industrial map of Germany would show that the principal manufacturing centers are a considerable distance inland. It is said that if we were to draw a straight line from the focus of the coal and iron industries (Rhine-Westphalia, cf. § 397) to its nearest harbor, Antwerp, the distance would vary from 100 to 150 miles. Berlin is 90 miles away from the sea, and all the other manufacturing centers are separated from their nearest harbor outlets by distances of from 200 to 350 miles. "It may be said, if we look at the German industries as a whole, that they are carried on at an average distance of more than 200 miles from their harbors."¹ As compared with England, where the principal industrial plants are located from 10 to 30 or 40 miles from the sea, it would appear that Germany is at a great disadvantage; hence the necessity of perfecting a system of inland transportation. This has been done by building railways and by developing the inland water ways—which in Germany supplement rather than compete with the railways.

The railways are chiefly owned by the government; their length is now over 36,000 miles, of which mileage only about one twelfth

¹ Barker, *Modern Germany*, pp. 407-408.

is owned by private companies. The principal lines connect the manufacturing and commercial towns and cities; Berlin is a great railway center. Two of the railway lines crossing the Alps beyond the frontier of Germany are of primary importance to German commerce, namely, the roads whose routes traverse the St. Gothard tunnel and the Brenner Pass; the former connects the densely populated section of the Empire with northern Italy via Switzerland, while the latter "is the direct route between the most populous parts of Middle Germany (including Berlin) and the eastern part of the northern Italian plain."¹

Germany has an excellent system of natural and artificial inland water ways and these have been made the object of study by the Inland Water-ways Commission of the United States (§ 310). In England, and in the United States as well, the water ways were either neglected or they were not kept up to modern standards after the introduction of railways; but this has not been the case in Germany. Her water ways have been steadily extended and improved, and this work is still being carried on at the present day. The natural embankments of the rivers have been replaced by solid masonry walls, the channels have been deepened, and provisions have been made to minimize the obstruction by ice during the winter months. Within the last twenty-five years upwards of \$5,000,000 have been expended upon the river bed of the Rhine alone, this river with its tributaries affording the best system of inland navigation within the Empire. Cologne has been made a seaport for a large fleet of specially built steamers, which carry on trade regularly between that inland port and points in England, Scandinavia, and Russia. For a considerable distance farther down the Rhine, as also on its tributaries, large river boats can now be navigated. The result is that this river system, once noteworthy chiefly for its romantic scenery, has been transformed into a great highway for the promotion of industry.²

In all, Germany has over 8500 miles of inland water ways; there are about 5000 miles upon large streams (exclusive of tributaries), of which the principal are the Rhine, Elbe, Oder, Weser, Danube, Ems, and Vistula. The quantity of goods transported by water, as well as the aggregate tonnage of vessels employed in the service, have increased enormously during the last quarter of a century; from 1882 to 1902 the tonnage of the inland fleet increased from a little over 1,500,000 to about 4,785,000 tons.

¹ Chisholm, *Handbook of Commercial Geography*, p. 276.

² See the chapter on Waterways and Canals in Barker's *Modern Germany*, pp. 406-438.

399. Foreign commerce. Both the domestic and foreign commerce of Germany have undergone a rapid expansion during the recent economic development of the country. The former has been extended to an even greater degree than has the latter. As a result of the metamorphosis of the Empire from an agricultural to a manufacturing and commercial nation, the character of the foreign trade has changed in many particulars: formerly foodstuffs and raw materials constituted the bulk of the exports, and manufactured goods were the leading imports; to-day the reverse is the case. The total value of the foreign trade has grown, especially since 1895, with astonishing rapidity: in the decade 1890-1900 the figure rose from about \$1,800,000,000 to approximately \$2,650,000,000; in 1907 it had risen to \$3,834,000,000—the imports being valued at \$2,144,000,000 and the exports at \$1,690,000,000. An analysis of these statistics shows that raw materials and half-finished products form slightly more than 50 per cent of the imports; foodstuffs and provisions about 25 per cent; manufactures less than 22 per cent; while living animals make up the balance. With reference to the exports, the same four classes embrace respectively 21.9, 7.7, 70.2, and .2 per cent of the whole. Some of the largest single items among the imports are raw cotton, wool, wheat, barley, copper, and raw silk; while among the leading articles of export are machinery, coal, woolen cloth, silk goods, cottons, gold ware, and electro-technical products. The United States furnishes Germany with more imports than does any other country; this is due to the presence on the import list of such commodities as raw cotton, breadstuffs, copper, lard, kerosene, and tobacco. The United Kingdom is the principal market for German exports, the leading items being sugar, cottons and cotton yarns, wood and its manufactures, and woollens and woolen yarns. Since 1879 the commercial policy of Germany has been one of protection.

Conscious efforts to promote foreign commerce are carried on in a thoroughly German, i.e. systematic, manner; and in this work there is close coöperation between the government and the business interests (cf. § 320). An Imperial Consultative Board, which came into existence in 1898 and which consists of thirty-two members, is the connecting link; one half of the members are designated directly by the Chancellor of the Empire, while the others receive their appointments upon the recommendations of various commercial associations. The opinions of this body carry considerable weight in shaping the government's policy in matters relating to foreign commerce.

400. Foreign possessions. The over-sea possessions of Germany have all been acquired since 1884. "In extent her colonial empire is inferior only to those of England and France; but its quality is that which usually marks the portion of the late comer."¹ Its area is over 1,000,000 square miles and the estimated population is over 12,000,000. The various colonies or regions here included are scattered widely — in Africa, Asia, and the Pacific; but none of them are really satisfactory to the commercial interests which had so large a part in calling them into existence. Those in Africa are by far the most extensive and include the bulk of Germany's colonial population; they are Togoland, Kamerun, German Southwest Africa, and German East Africa.

¹ Keller, Colonization, p. 546.

CHAPTER XXVIII

MISCELLANEOUS PRODUCTS

401. Introductory. We have now examined, in outline at least, the leading features in the commercial geography of the United States and of the British and German Empires. As already mentioned,¹ it would not be in accordance with the general plan and purpose of this book to continue with a discussion of the products and trade of other countries of the world. Still there are various materials of commerce, some of great importance, which are now obtained either exclusively or predominantly outside the political limits of the nations already considered. In the present chapter will be treated some of the more important commodities which either have not been mentioned as yet or which have received but casual notice.

402. Rice. This plant, which is known botanically as *Oryza sativa*, belongs to the grass family and bears a somewhat close resemblance to corn and millet. There are many evidences of its very early cultivation. De Candolle² has pointed out that "rice existed, perhaps, before all cultivation in southern Asia from China to Bengal, as is shown by the variety of names in the monosyllabic languages of the races between India and China." There are numerous varieties of the domesticated plant; on the island of Ceylon over 160 varieties have been found, while in Japan, China, and India 1400 have been reported. These differ in many particulars, such as yield, hardness, size, shape, color, and chemical composition of the grain.³ Rice is clearly a tropical or semi-tropical plant. The best soil for its culture is a clayey loam, and conditions which make irrigation possible are desirable. In general, however, rice may be grown successfully on any soil suitable for the production of cotton or wheat, provided also that the climatic conditions are favorable.

This cereal is the staple article of diet for a large proportion of the world's population; in addition, it is used extensively in the

¹ Pp. 250-251.

² Origin of Cultivated Plants, p. 387.

³ See Knapp, "Rice Culture in the United States," in *Farmers' Bulletin No. 110*, United States Department of Agriculture, from which a good many of the accompanying facts concerning rice have been obtained.

wheat-eating countries as more or less of a delicacy. It is rich in starch and has a comparatively small percentage of other food materials. Leguminous plants, such as beans and peas, grow well in the same habitat as rice, and they furnish a supplementary food rich in the nitrogenous elements. This combination again is vastly cheaper than wheat and meat, and the area required for the production of a year's food for a given population living on rice and leguminous plants is only a fraction of that required for the production of the diet of the same population if it consumes primarily meat and wheat bread. Herein is found one of the reasons why China proper can support a very dense population while still on the agricultural stage of the arts. No complete and accurate statistics of the world's rice crop are to be found. Hunt¹ estimated that "the production of rice is about one half that of maize or wheat, somewhat less than that of oats, and somewhat more than that of barley." Asia is *par excellence* the great rice-growing region, the crop being widely cultivated excepting in the northern part of the continent. In addition to the large yields of China and of India (§ 376), other Oriental countries, notably Japan, Siam, and Java, are important producers, although the crops in many instances are scarcely sufficient to meet the local needs.

Rice was introduced into the warmer countries of western Europe in comparatively modern times. It is stated that the Saracens brought it to Spain; in Italy its first cultivation dates from after the middle of the fifteenth century. White rice, so called from the white or creamy color of the husk, is the variety originally introduced into the United States; its culture began at Charleston in 1694.² The scene of our rice industry has so shifted within recent years that Louisiana and Texas — rather than South Carolina and Georgia as formerly — are raising practically the total product. This shifting of the productive area was due largely to the influence of some northern farmers who were familiar with modern farming methods in the wheat-growing districts of the Northwest. In 1884–1885 they moved southward to the prairie region extending along the Louisiana coast to the Texas boundary. Here they commenced growing rice by the use of machinery; irrigation also was practiced, and soon the cost of production was greatly reduced. To-day about one half of the total crop is a variety recently introduced from Japan, called Kiusiu (cf. § 214). It has been able quickly to supplant the old

¹The Cereals in America, p. 378.

²It should be stated that rice probably was brought to Virginia as early as 1647.

varieties, largely because the grain is shorter and mills¹ to greater advantage than the longer and more slender kernel of the golden-seed or white rice. The breakage of the kernel in milling Kiusiu is about 10 per cent as compared with something like 40 per cent in the case of other varieties.

Wild rice is a plant native to large areas of America extending from Texas to Canada. It is more common, however, in the north central section of the United States and in south central Canada. The aborigines of America have long used it as food, preparing it by parching. At the present day wild rice with game is a popular dish in certain sections of the country.

403. Barley. This cereal belongs, as do wheat and rye (§§ 218, 395), to the tribe of grasses called *Hordeae*, and in general appearance as well as in habits of growth the plant resembles wheat. It must be classed among the very earliest of cultivated plants, which accounts, in part at least, for the great number of varieties in existence to-day (cf. § 218). De Candolle recognized three leading types of this cereal, — two-rowed barley (*Hordeum distichon*), common barley (*Hordeum vulgare*), and six-rowed barley (*Hordeum hexastichon*). One of the varieties of the first type has been discovered growing wild in western temperate Asia, but neither the second nor the third type has been so found. Six-rowed barley was the kind most generally cultivated at first; it has been found in very ancient Egyptian monuments and in the remains of the lake dwellings. The two-rowed type was domesticated also in early times, but probably the common sort came into use later than the others. In Europe, at the present day, two-rowed barley is the kind which is raised for malt, but where animal food is the motive for its production the six-rowed type is preferred. Until comparatively recent times barley was used extensively for human food, but with the increase of wealth and culture, apparently through a process of selection, wheat has now supplanted it.

Barley is the hardiest of the cereals, having been grown with good results as far north as 70° latitude (cf. § 219). Still it can be grown successfully in a comparatively warm climate, which shows that the plant is adapted to a wide range of climatic conditions. Considerable care must be exercised, however, especially in such matters as crop rotation, selection of soil, and manuring. Professor Hunt² says the

¹ The rice when threshed is called "paddy," or rough rice. It is milled in order to remove the husk and the closely fitting cuticle, and to polish the seed. Polishing is done largely to meet the demand of fashion, although this process removes a part of the grain which is rich in nutriment.

² See *The Cereals in America*, p. 329.

indications are that the nature of the soil makes more difference with barley than with any other cereal crop. The world's yield of barley during the past few years has not varied much from 1,250,000,000 bushels.¹ Over 70 per cent of the annual crop is grown in Europe, and about 70 per cent of this is produced by Russia, Germany, and Austria-Hungary; the yield of Russia alone is considerably more than one quarter of that of the whole world. In the United States the production of barley is increasing at a rapid rate; both the acreage and output are more than double what they were a few years ago. Minnesota, Wisconsin, Iowa, and the Dakotas produce over 60 per cent of the total crop, while the Pacific Coast States (California, Oregon, Washington, and Idaho) add nearly 30 per cent more. The grain grown in the latter region is nearly all exported; but most of that which is produced east of the Rocky Mountains is consumed at home. The average yield per acre is about the same as that of corn (§ 217).

404. Buckwheat. This plant is not classed by botanists as a cereal, although for all practical purposes it may be so considered, and, in fact, it is often discussed along with the cereals. Among the close relatives of buckwheat are dock, sorrel, smartweed, and some other noxious plants. Its native home was in Asia, probably in Manchuria and central Siberia, where it has been found growing wild. It has not been cultivated for as long a time as most of the true cereals; apparently it was unknown to the Egyptians, Greeks, and Romans. The plant was introduced into Europe in the Middle Ages, its cultivation in Germany being first recorded in 1436; and not long after the arrival of the first European settlers in America buckwheat was being raised here. The crop comes to maturity more quickly than any of the true cereals, and is adapted to a light sandy soil and to a comparatively cold climate. Hence it is cultivated to the greatest extent in such regions as northern Europe, the cooler portions of Asia, and Canada. Reliable estimates of the world's yield of buckwheat are not available.

In the United States it is both relatively and absolutely a less important crop than it was in former years. In 1866 nearly 23,000,000 bushels were produced, but never since that time has the crop reached this figure. The present yield is about 15,000,000 bushels, which is approximately the average for a number of years past. New York and Pennsylvania together grow nearly three fourths of the

¹ The world's average annual production of barley in bushels by continents from 1903 to 1907 inclusive is shown in the Appendix, Table XXIII.

country's output. The seed is used to some extent for general animal food, but more especially for poultry. The flour is made into buckwheat cakes — a common dish in certain sections of the United States and Canada.

405. Sugar cane. Sugar cane (*Saccharum officinarum*) is cultivated widely, though chiefly within the tropics. The world's production of cane sugar is shown in the Appendix.¹ The countries which lead in cane-sugar output are British India, Cuba, Java, Hawaii, and Brazil; the first three together contribute considerably more than one half of the world's commercial supply. The sugar cane is a large grasslike plant, reaching sometimes a height of 20 feet, with a spongy stem 2 to 4 inches thick. Its original home appears to have been in southern Asia, probably between Bengal and Cochin-China. Gradually its culture spread westward, reaching the Mediterranean countries through the Arabs during the Middle Ages. It was introduced into Brazil early in the sixteenth century, reached Haiti in 1520, and Mexico shortly afterwards. The best climatic environment for raising sugar cane is where the average temperature is about 80° F. and the rainfall 60 inches or more per annum; but the plant is not overexacting as regards climatic requirements, for it thrives in New South Wales and Natal.

In the United States, Louisiana is now and has been in the past the principal scene of cane-sugar production. Culture began as early as 1751, but without any important results; it was not until fifty years later that a sugar crop "large enough to influence the future of Louisiana and profitable enough to justify others to embark in the enterprise" was harvested. From this time on planters began to cultivate the crop. Until 1820 the two varieties of cane most cultivated were *Creole*, which originated in Malabar or Bengal, and *Tahiti*; both were ill adapted to the climatic conditions of large parts of Louisiana. In 1820 the purple and red ribbon canes, natives of Java, were introduced, and their superiority over other varieties in withstanding greater cold enabled plantations to be started farther north than before, thus greatly enlarging the area of production. The annual yield of cane sugar in the United States varies from 230,000 to 365,000 long tons, and of this all but a few tons (approximately 15,000, raised chiefly in Texas) is produced in Louisiana.

406. Flax. In a previous chapter (XV), which dealt with the important vegetable products of the United States, we considered the general character of the flax plant and the method of its culture

¹ Table XXII.

for the seeds (§ 228), inasmuch as it is for these that the crop is raised in this country. But, as already pointed out, there is another valuable product—the fiber—for which the plant is grown, although unfortunately it is not practicable to harvest from a single crop seeds of good quality as well as stems which contain a good fiber. This is the reason why, the world over, flax is raised either for one crop or the other, but seldom for both. In order to make the study of this important product more complete, there still remains for us to consider its production for the fiber.

So far as quantity is concerned, European Russia far surpasses all other countries in yield, contributing about 70 per cent of the world's annual output. Austria-Hungary, France, Italy, Belgium, Ireland, and the Netherlands are other important sources of supply, and the product of some of these countries, notably Belgium and Ireland, is of a very superior quality. An intensive system of culture is desirable in order that the best fiber may be raised.¹ Usually the crop is harvested by hand labor, the whole plant being pulled up by the roots. The stems are carefully placed side by side to form a bundle and are then dried. Afterwards the seeds are removed by threshing, and then the "straw" is put through several processes which serve to separate the fiber from the rest of the plant. These have been well described as follows:

"The retting or steeping, which depends ultimately upon the action of bacteria, is carried out in three different ways in various parts of the world. The simplest method, known as dew-retting, is that adopted in North America and Russia, where the bundles are simply spread evenly over the surface of a damp meadow, and the natural moisture of the soil, dew, and rain allowed to separate the bast from the woody tissue. In Ireland the flax is retted in pools of soft water, the pools being either natural or artificial. The sheaves are packed loosely under water, so that, if possible, they do not come in contact with the bottom of the pond, and after about ten days the fiber sinks to the bottom of the pond, and the process of decomposition is regarded as complete. The turbidity of the water during the whole period indicates the activity of the fermentative organism.

"In Belgium the straw is retted in the river Leys, the water of which is said to be unrivalled for the purpose. . . . When the flax is considered to be sufficiently retted it is finally dried in the fields, and then subjected to a "breaking" process which fits it for the final scutching. The breaking is effected by machinery, and consists essentially in breaking up the stems of the plant between rollers in order to separate the woody tissue from the fiber. . . . During the scutching process the fiber is freed from the woody particles and rendered fit for the market. Hand-scutching still survives in some countries, but scutching machines are extensively employed in all the great flax-growing districts."²

¹ Cf. Taussig, *The Tariff History of the United States*, pp. 367-368.

² Freeman and Chandler, *The World's Commercial Products*, pp. 314-315.

Retting by immersion seems to be necessary in order to get fiber of the best quality, but the hand labor which is required in removing the bundles from the bad-smelling pools is disagreeable to the last degree.

407. Hemp. This is another important soft or bast fiber (§ 223) and furnishes a convenient substitute for flax in all but the finest fabrics. Unfortunately its name has in recent years been applied to a number of hard fibers such as sisal hemp, Manila hemp, and New Zealand hemp. The true hemp (*Cannabis sativa*) is an annual belonging to the nettle family; its original home was central Asia, and it has been cultivated in China since very early times. At the present time Russia easily leads in the production of hemp, although it is a more or less important crop in China, Japan, Italy, Austria, France, and the United States. The fiber is long (10 feet or more), soft, and very strong. The best is creamy white in color; unlike flax it cannot be bleached perfectly white. The processes employed in separating it from the stocks of the plant are very much like those used in getting the flax fiber. From earliest times hemp was, next to flax, the most commonly used vegetable fiber until the advent of the cheaper cotton and jute. In the United States it is raised for the fiber; elsewhere it is produced for its seeds also, from which an oil similar in nature to linseed is obtained; again, it is the source of an intoxicating drug called "bhang," which is made from exudations from the stem and leaves of the plant.

Hemp production in the United States reached its highest point in 1859, when nearly 150,000,000 pounds of the fiber were grown; since that date the decline has been rapid, until now something like 10,000,000 pounds are raised annually. Among the causes which have been assigned for the decreased production are the introduction of Manila (§ 323), the large importations of jute (§ 376), the decline in price of hard-cordage fibers such as sisal (§ 409), and the use of cotton (§ 224) for twine and yarns. The state of Kentucky alone, in the famous blue-grass region, grows upwards of three quarters of the total crop, Lexington being the center of the industry and the principal hemp market. The present use of the fiber is for yacht cordage, ropes, fishing lines, linen crash, and in the general manufacture of carpets and rugs.

408. Ramie. This soft fiber is known also as rhea and China grass, and is obtained from two closely related plants of the stinging-nettle family. China grass is derived from the stem of *Bœhméria nivea*, and rhea, or ramie, from *Bœhméria tenacissima*. The leaves of the former are white on the under surface, while those of the latter

are green ; moreover, the stems of the former are less woody than those of the latter. The commercial product of both plants is popularly known as ramie. *B. nivea* is the variety that was earliest known, and it was probably native in China and Japan. For a long time it has had a limited growth in eastern Asia, and at present both varieties are produced there and in other regions, notably in India and in the Mediterranean countries.

The plants are perennial, the roots sending forth slender shoots from 4 to 6 feet in length. The fibers are found directly beneath the outer bark and are joined to the bark and to the wood, as well as to each other, by a sticky glutinous substance. Consequently, there has always been considerable difficulty in freeing the fiber from the stalk. The plant may be grown successfully on a variety of soils and in a comparatively wide range of climate. It has been raised in an experimental way in this country and it seems to be adapted to the physical conditions in the Gulf States. Ramie is suitable for the making of cordage, nets, tent cloth, and various other articles which are now made from hemp and jute. It mixes well with wool and cotton, giving the fabric a silky finish. The highly refined product, when woven by itself, results in a durable, fine, lustrous goods. Efforts are being made to extend the growing of ramie, an interesting movement being an attempt to form a Ramie Growing Association to foster the growth of the plant throughout the British Empire.

409. Sisal. The plant which bears the hard fiber known as sisal, or henequen (the latter name is commonly applied in Spanish-speaking countries), is a species of the *Agave*, to which the century plant belongs. It is known botanically as *Agave rigida* and seems to have been native in Yucatan, Mexico. The plant has been introduced into various tropical countries, but its production for commercial purposes is confined to Yucatan primarily, and to the West Indies and Hawaii in a more limited extent. The fiber, which is from 2½ to 4 feet in length, is obtained from the yellowish-white leaves of the plant by removing the fleshy part. It is harsher and stiffer than Manila (§ 323), but is not so strong. Salt water is destructive to cordage made from sisal ; consequently, it is used more in the manufacture of such articles as binder twine, sacking, and brushes. With the exception of cotton, sisal is probably the fiber most widely used in the United States.

410. Istle. Istle, or Tampico fiber, is derived from several different species of plants which grow wild on the arid table-lands of northern Mexico and southern Texas. There are now recognized three principal types of this fiber, — Jaumave istle (*Agave lophantha*), Tula istle

(principally from *Lamnella carnerosana*), and Palma istle (*Agave lecheguilla*). The first is a whitish flexible fiber from 20 to 40 inches in length; the second is coarser, stiffer, and shorter than the first; the third is of about the same length as the second, yellowish in color, and rather gummy. Istle has been used for some time as a substitute for bristles in the manufacture of brushes, and it is worked up into cheap twine and medium grades of cordage.¹

411. Silk. The raw silk of commerce is derived largely from the cocoons formed by several varieties of domesticated silkworms (cf. § 160), although a considerable quantity is obtained from various moths which are still in a state of nature. The principal food of the silkworm consists of mulberry leaves, which, for the cultivated varieties of the animals, are gathered and fed to them under cover. The material which later becomes the fiber is to be found within the body of the worm in the form of jellylike masses, which harden upon being exposed to the air. "When the worm is about to pass into the still condition which answers to the chrysalis of a butterfly, it sends out this substance by two minute openings at its head, and the two streams, at once uniting, form an extremely fine thread, which the worm coils around it, so as to form what is called a cocoon."² Great care has to be taken in unwinding the silk from the cocoons, and, in order to get a thread sufficiently coarse for making into fabrics, several have to be twisted together. The number varies from about 5 to 20, according to the use to which the thread is to be put. In general, the amount of raw silk obtained from the cocoons varies from 9 to 15 per cent of their gross weight, depending upon the care exercised in rearing the worms as well as upon the particular breed.

According to the estimates of the Silk Manufacturers' Association of Lyons,³ the world's production of raw silk in recent years has varied from about 40,000,000 to nearly 50,000,000 pounds. The largest producers are China and Japan, whose exports alone total about one half of the world's output. In 1907 the exports from Shanghai and Canton amounted to over 14,000,000 pounds, while those from Yokohama were about the same figure. The third largest producer is Italy (10,626,000 pounds in 1907), and next in order are Asiatic Turkey and France. The full list of countries producing raw silk and their various contributions to the world's supply would show that this

¹ See Dewey, "Principal Commercial Plant Fibers," reprinted from Yearbook of the United States Department of Agriculture, 1903; and Hunt, Forage and Fiber Crops in America, p. 401.

² Chisholm, Handbook of Commercial Geography, p. 104.

³ See Yearbook of the United States Department of Agriculture, 1908, p. 709.

commodity comes largely from Asia and the European countries bordering on the Mediterranean. There are many other regions, however, where the mulberry tree thrives and where the climatic conditions would permit of the raising of silkworms ; but the hand labor which is necessary in their rearing and in the preparation of the skeins of the raw silk for the market practically excludes the industry from those countries, such as the United States, where wages are high (cf. § 278).

Among the great European silk-manufacturing centers are Lyons, Krefeld, Milan, Ste. Étienne, and Elberfeld. The United States imports an enormous quantity of the raw product and is one of the greatest silk-manufacturing countries in the world. Although the industry is carried on extensively at various places in a number of states, Paterson, New Jersey, is the chief center (cf. § 278).

Artificial silk has been made from wood pulp by a process involving the use of nitric acid. The nitro-cellulose thus formed is dissolved in a mixture of alcohol and ether, and the solution is forced through microscopic holes in a thin metallic plate. A "setting" bath for the filaments thus formed enables them to be twisted into a workable thread. Goods made from artificial silk look well, but they are less elastic and are said not to wear as well as those made from real silk.

412. Rubber. Crude rubber is derived from a number of different species of trees, shrubs, or vines which were natives of and which still grow mainly within the tropics (cf. § 156). It is a coagulated milky sap obtained either by cutting down the tree or plant, or by "tapping" it so that the sap will flow out from the incisions made in the bark. Formerly all the rubber of commerce was obtained from the plants in their wild state ; but the great demand for the commodity in recent years, its rapid advance in price, and the wholesale destruction of the plants have resulted in the starting of numerous rubber plantations in many parts of the world where the soil and climatic conditions permit of the enterprise. In Mexico alone there are said to be upwards of 100 rubber estates, while in Ceylon, the Malay Peninsula, and other regions of Asia many are to be found which are said to be paying investments.

The principal source of the world's rubber supply is Brazil, especially in the valley of the Amazon, which contributes more than one half of the total annual output. Other important regions of supply are Africa (notably the Congo Free State), Ceylon, Burma, the Malay Peninsula, Mexico, and Central America. Probably the leading species of rubber-bearing tree in Brazil is one which belongs to the genus *Hevea*, and is known as *Hevea brasiliensis*, or more popularly

as the Pará rubber tree. It often reaches a height of 60 feet or more, and attains a circumference of from 8 to 10 feet. The rubber is collected largely by natives, who bring it down to collecting stations along the Amazon. In 1907 the exports of this commodity from Brazil amounted to nearly \$62,500,000, or about one quarter of the total value of all foreign shipments. The Pará rubber tree is the kind which has been introduced with success into other countries, especially into Ceylon and other regions of Asia.

413. Coffee. The coffee plant is a member of the family *Rubiaceæ*, which embraces a number of useful tropical plants including cinchona and madder. The genus *Coffea* has numerous species, but of these only two or three are cultivated. The plant seems to have been native in Abyssinia and, probably, in other regions of tropical Africa. There is little or no evidence of its early cultivation, but its use in Abyssinia as a beverage dates from very early times — the berries being obtained from the wild plants in the forests. Introduced into Arabia near the opening of the fifteenth century, the coffee plant was found to be excellently adapted to the soil and climatic conditions in the region of Mocha, and to such a degree was this the case that Mocha came to be regarded by some as its original home. In the seventeenth century coffee came to be known and to be consumed, to some extent, in the west of Europe, and Arabia was the main source of supply. In the same century the Dutch are credited with its successful introduction into Java, and soon the coffee yield of this island supplied the Amsterdam market. Other regions, notably Ceylon and the West Indies, were at times leading producers; but at the present day Brazil is the great source of supply of the coffee of commerce, yielding approximately three quarters of the world's total output. In fact, this commodity is the leading agricultural product of Brazil.

Coffee was introduced into Brazil in the early part of the eighteenth century, and its culture became an important industry towards the close of the same century. Although large areas of the country are adapted to the raising of coffee, most of the crop is confined to the four southeastern states, — São Paulo, Rio de Janeiro, Minas Geraes, and Espirito Santo. The former is the greatest coffee-growing district in the world, having upwards of 15,000 plantations, many of which have over 200,000 trees. The United States leads the world in the amount of coffee imported, the figure standing at over 940,000,000 pounds in 1907. In per capita consumption,¹ however, we are surpassed by

¹ The per capita consumption of coffee in the United States is upwards of eleven pounds per annum.

Holland, Norway, and Sweden. Great Britain enjoys a large trade in coffee, but, so far as actual consumption is concerned, she stands near the foot of the list, tea being the common beverage of the people.

414. Tea. The tea of commerce is derived from the young leaves of a shrub, *Thea sinensis*, which in its natural state grows to the height of several feet; for its successful culture the plant must be liberally pruned. It is not possible accurately to determine whether the original home of the plant was in China or India, although the leaves seem to have been used in the former country earlier than in the latter. At the present day tea is cultivated widely in a number of countries included within the parallels of 39° N. (in Japan) and 30° S. (in Natal), although China, India, and Ceylon are the greatest producers. It is impossible to secure complete and accurate statistics, but it is highly probable that the tea crop of China far surpasses that of India, in spite of the fact that in recent years the latter has been leading in the quantity of exports. The domestic consumption of tea in China is enormous; a few years ago it was estimated at 2,000,000,000 pounds as against 500,000,000 for the rest of the world. Excepting in the northern part of the Empire, the plant is cultivated widely, although the exports originate largely in the southeastern provinces.

Tea has been used in China from very early times,¹ but its use in Europe dates from about the middle of the seventeenth century, as was the case with coffee (§ 413) and cacao (§ 415) also. There are various methods of cultivating the plant and of manufacturing the commodity for export. That which is sent abroad is either green, black, or brick tea. Brick tea consists of fragments of broken leaves and stalks which are compressed into blocks of varying sizes, and these are sent overland in great numbers to the markets of central Asia. It used to be thought that green and black teas were each derived from a different species of plant, but now it is known that the different types are a result of differences in the processes of manufacture. An examination of the statistics of consumption reveals the striking fact that the people of the United Kingdom and several of the colonies, notably Australia, New Zealand, and Canada, are great tea drinkers² as compared with those of other countries, while British India and Ceylon are their principal sources of supply.

¹ De Candolle, *Origin of Cultivated Plants*, p. 118.

² The approximate annual per capita consumption of tea in the United Kingdom is 6 pounds; in Australia, 7 pounds; in New Zealand, 6½ pounds; in Canada, 5½ pounds; in Holland, 1½ pounds; in the United States, 1½ pounds; and in Russia, 1 pound. See "The World's Production and Consumption of Coffee, Tea, and Cocoa in 1905," in the *Monthly Summary of Commerce and Finance* for July, 1905, p. 118, United

415. Cacao. This commodity, known also as cocoa, is derived from a plant whose technical name is *Theobroma cacao*, a native of tropical America. This plant should not be confused with *Erythroxylon coca*, a shrub from which the drug cocaine is derived, nor with *Cocos nucifera*, whose fruit is the well-known cocoanut. The genus *Theobroma* includes a dozen or more species, but the only one of commercial importance is that which is mentioned above. When America was discovered the plant was being grown in various regions within the tropics, and "the custom of drinking chocolate was general."¹ At times the seeds (cacao beans) were used as money in Mexico, and a similar custom is said to have prevailed in Peru. The Spaniards were fond of the beverage prepared from cacao, and introduced its use into Europe; they are also credited with spreading the culture of the plant to the Philippines towards the close of the seventeenth century.

The plant requires a rich, well-watered soil and a humid atmosphere; in its natural state it attains a height of nearly 20 feet and sometimes considerably more, but it is kept much lower by pruning. Usually the cacao trees are protected from winds and sunlight by planting among them larger species such as the coral-bean tree — the one most commonly used. The cacao beans of commerce are contained in pods shaped somewhat like a thick cucumber, but with ends rather sharply pointed. Three or four dozen beans or even more are borne in a single pod. The tree comes into bearing in the fourth or fifth year, and under ordinary conditions is productive for a period of thirty years or more. The crop is harvested twice per annum, although pods in all stages of development are to be found on the tree at any time of the year. After the seeds are removed from the pods they are allowed to ferment and are then dried. The next process is roasting, which seems to develop the aroma of the seeds and renders them soluble and digestible. They are then broken into "nibs," from which the shells and foreign matter are removed, and ordinarily the "nibs" are ground into a powder from which the beverage commonly known as cocoa is made. Chocolate is no more than a mixture of cacao and sugar, to which a flavoring extract such as vanilla is generally added.²

States Department of Commerce and Labor. This is a rather extensive study of the non-alcoholic stimulants, from which some of the facts in this section as well as those on coffee and cacao have been taken.

¹ De Candolle, *Origin of Cultivated Plants*, p. 314.

² The raw cacao beans contain a large percentage of fat, which, in the manufacture of the cacao powder, is extracted and forms the cacao butter of commerce. It has a considerable use in the manufacture of medicinal salves.

The world's annual cacao crop is not far from 150,000 tons, and about three quarters of this is derived from tropical South America and the West Indies. Most of the remainder comes from western Africa, Ceylon, and the Dutch East Indies. Ecuador has usually been the country of greatest production, having about one fifth of the total output; but within recent years the yield of São Thomé and of Brazil has differed but little from that of Ecuador, while Trinidad, San Domingo, and Venezuela are important contributors. Cacao is Ecuador's principal product, being raised largely in the valleys of the coast and in the lowlands; a few years ago there were reported to be nearly 5000 cacao plantations, containing upwards of 58,000,000 trees. The United States consumes more cacao than any other country in the world, but the country of largest per capita consumption is Holland, where about 5 pounds per head of population are consumed yearly.

416. Platinum. Platinum is a heavy metal resembling silver in color, and is exceedingly rare. It occurs in small pure grains mixed in sand, and in the form of ores. On account of its resistance to heat and acids, it is of great use in the chemical arts, notably for the making of crucibles; it is also used in the manufacture of dental supplies and for jeweler's purposes. It is indispensable in the gas- and electric-lighting industries for the wires leading into the lamps and tubes; and on account of the recent expansion in these industries both the demand and the price have greatly increased. Russia supplies over 90 per cent of the world's output. The placers occur on both the Asiatic and the European slopes of the Urals, the principal ones being near the basins of the rivers Iss, Vissim, and Martian. The annual consumption of platinum is greater than the production, as considerable quantities of the old metal come again into the market. In 1906 the value of the platinum output of the United States was \$45,189; California, Oregon, and Washington were the producing states. Certain copper-nickel ores in Utah and Nevada also bear platinum, and the metal occurs likewise in Canada and in the republic of Colombia.

APPENDIX

TABLE I. Percentage area devoted to the production of each cereal in the United States according to the Twelfth Census.

Maize	51.3
Wheat	28.4
Oats	16.0
Barley	2.4
Rye	1.1
Buckwheat	0.4
Kafir corn	0.2
Rice	0.2
Total	100.0

TABLE II. Average annual production of maize in bushels by continents from 1903 to 1907 inclusive.

North America	2,680,000,000
Europe	459,000,000
South America	154,000,000
Africa	37,000,000
Australasia	8,000,000
Total	3,338,000,000

TABLE III. Average annual production of wheat in bushels by continents from 1903 to 1907 inclusive.

Europe	1,765,000,000
North America	760,000,000
Asia	446,000,000
South America	155,000,000
Australasia	64,000,000
Africa	51,000,000
Total	3,241,000,000

TABLE IV. Number of bushels of wheat produced in the principal wheat-yielding countries in 1907.

United States	634,087,000
Russia (European)	455,000,000
France	369,970,000
British India	315,386,000
Austria-Hungary	185,059,000
Italy	177,543,000

Argentina	155,993,000
Germany	127,843,000
Spain	100,331,000
Canada	96,606,000
Australia	68,185,000
United Kingdom	58,275,000
Russia (Asiatic)	56,000,000

TABLE V. Average annual production of oats in bushels by continents from 1903 to 1907 inclusive.

Europe	2,318,000,000
North America	1,093,000,000
Asia	77,000,000
Australasia	27,000,000
Africa	13,000,000
Total	3,528,000,000

TABLE VI. Production of cotton for mill consumption, by countries, 1907 and 1908. (From *Bulletin No. 100*, Bureau of the Census, Washington, D.C., 1909.)

COUNTRY	PRODUCTION (BALES OF 500 POUNDS NET)	
	1907	1908
United States	10,882,000	13,002,000
British India	2,498,000	2,914,000
Egypt	1,296,000	1,275,000
Russia	620,000	846,000
China	426,000	600,000
Brazil	370,000	425,000
Mexico	70,000	140,000
Turkey	80,000	80,000
Peru	55,000	57,000
Persia	50,000	50,000
Other countries	165,000	185,000
Total	16,512,000	19,574,000

TABLE VII. Production of flaxseed in bushels by countries, 1905 and 1906.

COUNTRY	1905	1906
United States	28,478,000	25,576,000
Argentina	29,133,000	23,303,000
Russia (European)	25,603,000	22,052,000
British India, including such Native States as report	13,896,000	14,128,000
All other countries	2,592,000	2,482,000
Total	99,702,000	87,541,000

TABLE VIII. Acreage, production in pounds, and farm value of tobacco in the principal tobacco-producing states of the United States.

STATE	ACREAGE	PRODUCTION	FARM VALUE
Kentucky	290,000	252,300,000	\$19,427,000
Ohio	70,000	74,200,000	8,533,000
Virginia	109,000	73,555,000	6,032,000
North Carolina	120,000	69,808,000	6,981,000
Wisconsin	39,000	39,725,000	6,713,000
Pennsylvania	26,000	35,750,000	4,898,000
Tennessee	44,000	34,069,000	2,555,000
Connecticut	14,000	24,533,000	4,416,000

TABLE IX. Annual value of the commercial fisheries of the United States, exclusive of the island possessions, for the years mentioned.

TERRITORIAL DIVISION	VALUE
Middle Atlantic States (1904)	\$18,963,976
New England States (1905)	14,184,205
Alaska (1906)	8,801,865
Pacific Coast States (1904)	6,680,866
Gulf States (1902)	3,494,196
South Atlantic States (1902)	2,849,633
Great Lakes (1903)	2,745,501
Mississippi river and tributaries (1903)	1,841,168
Minor interior waters (1900-1903)	425,929
Total	\$59,987,339

TABLE X. Pig-iron output of the world in tons (1906).

COUNTRY	TONS
United States	25,712,102
Germany	12,478,067
United Kingdom	10,210,178
France	3,319,032
Russia	2,350,000
Belgium	1,431,160
Austria-Hungary	1,403,500
Sweden	552,250
Canada	550,618
Spain	387,500
Italy	30,450
All other countries	650,000
Total	59,074,861

TABLE XI. Gold production by countries (1906).

COUNTRY	VALUE
British South Africa	\$129,376,000
United States	94,374,000
Australasia	82,391,000
Russia (European)	19,495,000
Mexico	18,535,000
British India	12,088,000
Canada	12,024,000
All other countries	32,059,000
Total	\$400,342,000

TABLE XII. Gold production in the United States¹ (1906).

STATE OR TERRITORY	VALUE
Colorado	\$22,934,400
Alaska	21,365,100
California	18,832,900
Nevada	9,278,600
South Dakota	6,604,900
Utah	5,130,900
Total	\$84,145,800

TABLE XIII. The world's approximate output of lead (1906).

COUNTRY	TONS
United States	350,000
Spain	200,000
Germany	160,000
Australasia	95,000
Mexico	70,000
Total	875,000

TABLE XIV. The world's annual production of coal.

COUNTRY	SHORT TONS
United States (1906)	414,157,278
United Kingdom (1906)	281,195,743
Germany (1906)	222,350,526
Austria-Hungary (1904)	45,209,933
France (1906)	37,823,931
Belgium (1906)	26,026,119
Russia and Finland (1905)	18,996,896
Japan (1905)	12,819,749
India (1905)	9,427,868
Canada (1905)	8,775,933
New South Wales (1906)	8,541,525
Spain (1906)	3,620,588
All other countries ²	17,532,618
Total	1,106,478,707

TABLE XV. Percentage production of crude petroleum from various fields in the United States for the years mentioned.

FIELD	1901	1902	1903	1904	1905	1906
Appalachian	48.45	36.07	31.41	26.83	21.80	21.93
Lima-Indiana-Illinois	31.61	26.31	23.97	21.08	16.68	17.35
Mid-continent	.27	.42	1.07	4.80	8.92	17.17
Gulf	6.33	20.99	18.79	21.52	27.50	17.11
California	12.66	15.75	24.27	25.33	24.81	26.17
All others	.68	.46	.49	.44	.29	.27
Total	100.00	100.00	100.00	100.00	100.00	100.00

¹ Twenty states and territories, including Alaska, figured in the output. The value of the product in all others than those mentioned above was \$10,228,000.

² Including South Africa, New Zealand, Mexico, Holland, Italy, Sweden, Tasmania, China, Turkey, Servia, Portugal, Colombia, Chile, Greece, etc.

TABLE XVI. Summary of the manufactures of the United States at given periods according to the Federal Census Bureau.

Year	Number of Establishments	Capital	WAGE EARNERS		Cost of Materials Used	Value of Products, Including Custom Work and Repairing
			Average Number	Total Wages		
		Dollars		Dollars	Dollars	Dollars
1850..	123,025	533,245,351	957,059	236,755,464	555,123,822	1,019,106,616
1860..	140,433	1,009,855,715	1,311,246	378,878,966	1,031,605,092	1,885,861,676
1870..	252,148	2,118,208,769	2,053,996	775,584,343	2,488,427,242	4,232,325,442
1880..	253,852	2,790,272,606	2,732,595	947,953,795	3,396,823,549	5,369,579,191
1890..	355,415	6,525,156,486	4,251,613	1,891,228,321	5,162,044,076	9,372,437,283
1900..	512,339	9,835,086,909	5,316,802	2,328,691,254	7,348,144,755	13,014,287,498
1905 ¹	216,262	12,686,265,673	5,470,321	2,611,540,532	8,503,949,756	14,802,147,087

TABLE XVII. Analysis of the manufacturing industries of the United States according to the Federal Census Bureau (1905).

GROUP	NUMBER OF ESTABLISHMENTS	CAPITAL	WAGES PAID	VALUE OF PRODUCTS, INCLUDING CUSTOM WORK AND REPAIRING
1. Food and kindred products . . .	45,790	\$1,173,151,276	\$164,601,803	\$2,845,234,900
2. Iron and steel and their products . .	14,239	2,331,498,157	482,357,503	2,176,739,726
3. Textiles	17,042	1,744,169,234	419,841,630	2,147,441,418
4. Lumber and its manufactures . . .	32,726	1,013,827,138	336,058,173	1,223,730,336
5. Chemicals and allied products . . .	9,680	1,504,728,510	93,965,248	1,031,965,263
6. Metals and metal products other than iron and steel	6,310	598,340,758	117,599,837	922,262,456
7. Paper and printing .	30,787	798,758,312	185,547,791	857,112,256
8. Leather and its finished products .	4,945	440,777,194	116,694,140	705,747,470
9. Vehicles for land transportation . .	7,285	447,697,020	221,860,517	643,924,442
10. Liquors and beverages	6,381	659,547,620	45,146,285	501,266,605
11. Clay, glass, and stone products . . .	10,775	553,846,682	148,471,903	391,230,422
12. Tobacco	16,828	323,983,501	62,640,303	331,117,681
13. Shipbuilding . . .	1,097	121,623,700	29,241,087	82,769,239
14. Miscellaneous industries	12,377	974,316,571	187,514,312	941,604,873

¹ Exclusive of neighborhood industries and hand trades.

TABLE XVIII. Tonnage of the American merchant marine in both the coastwise and the foreign trade for the years given.

Year	Tonnage of Coastwise Shipping	Tonnage of Shipping in the Foreign Trade
1789	68,607	123,893
1800	272,492	667,107
1810	405,347	981,019
1820	588,025	583,657
1830	516,979	537,563
1840	1,176,684	762,838
1850	1,797,825	1,439,694
1860	2,644,867	2,379,396
1870	2,638,247	1,448,846
1880	2,637,686	1,314,402
1890	3,409,435	928,062
1900	4,286,516	816,795
1903	5,141,037	879,264
1904	5,335,164	886,628
1905	5,441,688	943,750
1906	5,674,044	928,466
1907	6,010,658	861,466

TABLE XIX. Trade of the world by continents and the share of the United States therein. (From *Foreign Trade Figures*, p. 6, issued by the Bureau of Information of the Philadelphia Commercial Museums.)

EXPORTS

CONTINENTS	1900			1905		
	TOTAL	TO UNITED STATES	PER CENT TO U.S.	TOTAL	TO UNITED STATES	PER CENT TO U.S.
Africa	\$265,909,677	\$6,476,420	2.4	\$349,635,021	\$7,862,255	2.2
Asia	919,131,980	88,557,040	9.6	1,354,241,022	124,641,636	9.2
Europe	6,124,983,479	454,058,485	7.4	7,292,165,378	590,030,449	8.9
North America ¹	353,580,979	159,391,271	45.9	508,250,984	271,751,916	53.4
Oceania	317,449,733	29,744,965	9.3	395,565,837	24,933,545	6.5
South America . .	520,402,059	120,198,063	23.1	764,792,363	129,982,326	16.9

IMPORTS

CONTINENTS	1900			1905		
	TOTAL	FROM UNITED STATES	PER CENT FROM U.S.	TOTAL	FROM UNITED STATES	PER CENT FROM U.S.
Africa	\$388,057,594	\$15,700,725	4.1	\$371,071,502	\$19,866,077	5.3
Asia	885,872,793	50,659,974	5.7	1,441,802,712	118,205,536	8.2
Europe	7,989,380,386	1,396,043,328	17.4	8,795,290,759	1,278,688,965	14.5
North America ¹	387,638,866	204,001,966	52.6	533,586,189	286,192,167	53.6
Oceania	285,025,616	28,079,603	9.8	291,979,881	35,417,982	12.1
South America . .	329,085,680	44,707,799	13.6	521,775,013	61,102,107	11.7

¹ Exclusive of United States.

TABLE XX. Progress made in textile industries of the United Kingdom for years mentioned. (From Statesman's Year-Book, 1909, p. 70.)

AVERAGE PERIODS OF THREE YEARS	WEIGHT CONSUMED IN MILLIONS OF POUNDS				VALUE OF PRODUCTS EXPORTED IN THOUSANDS OF POUNDS STERLING			
	Cotton	Wool	Flax	Total	Cotton	Woolen	Linen	Total
1829-1831 . .	243.2	149.4	193.8	586.4	18.077	4.967	2.138	25.182
1859-1861 . .	1022.5	260.4	212.0	1494.9	49.000	15.041	6.119	70.060
1889-1891 . .	1618.0	564.0	220.0	2402.0	72.114	24.176	6.377	102.667
1893-1895 . .	1576.0	602.0	213.0	2391.0	64.697	21.597	5.848	92.142
1896-1898 . .	1668.0	624.0	236.0	2628.0	66.094	22.885	5.697	94.676
1899-1901 . .	1679.0	623.0	190.0	2492.0	70.340	20.898	5.857	97.095
1902-1904 . .	1585.0	582.0	192.0	2359.0	76.663	22.066	6.429	105.157
1905-1907 . .	1941.0	657.0	226.0	2824.0	100.676	28.253	7.956	136.885
1908 (1 year) .	1726.0	652.0	228.0	2606.0	95.068	25.767	6.706	127.541

TABLE XXI. Average annual production of rye in bushels by continents from 1903 to 1907 inclusive.

Europe	1,512,758,000
North America	32,875,000
Asia	30,287,000
Australasia	136,000
Total	1,576,056,000

TABLE XXII. Average annual production of cane sugar and beet sugar in long tons¹ by continents from 1903-1904 to 1907-1908 inclusive.

CONTINENT	CANE SUGAR	BEET SUGAR
Asia	3,210,000	—
North America	2,478,000	320,000
South America	637,000	—
Africa	309,000	—
Oceania	227,000	—
Europe	18,000	6,163,000
Total	6,879,000	6,483,000

TABLE XXIII. Average annual production of barley in bushels by continents from 1903 to 1907 inclusive.

Europe	891,913,000
North America	200,182,000
Asia	89,466,000
Africa	45,419,000
Australasia	3,189,000
Total	1,230,169,000

¹ The figure for beet-sugar production in Europe represents metric tons.

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